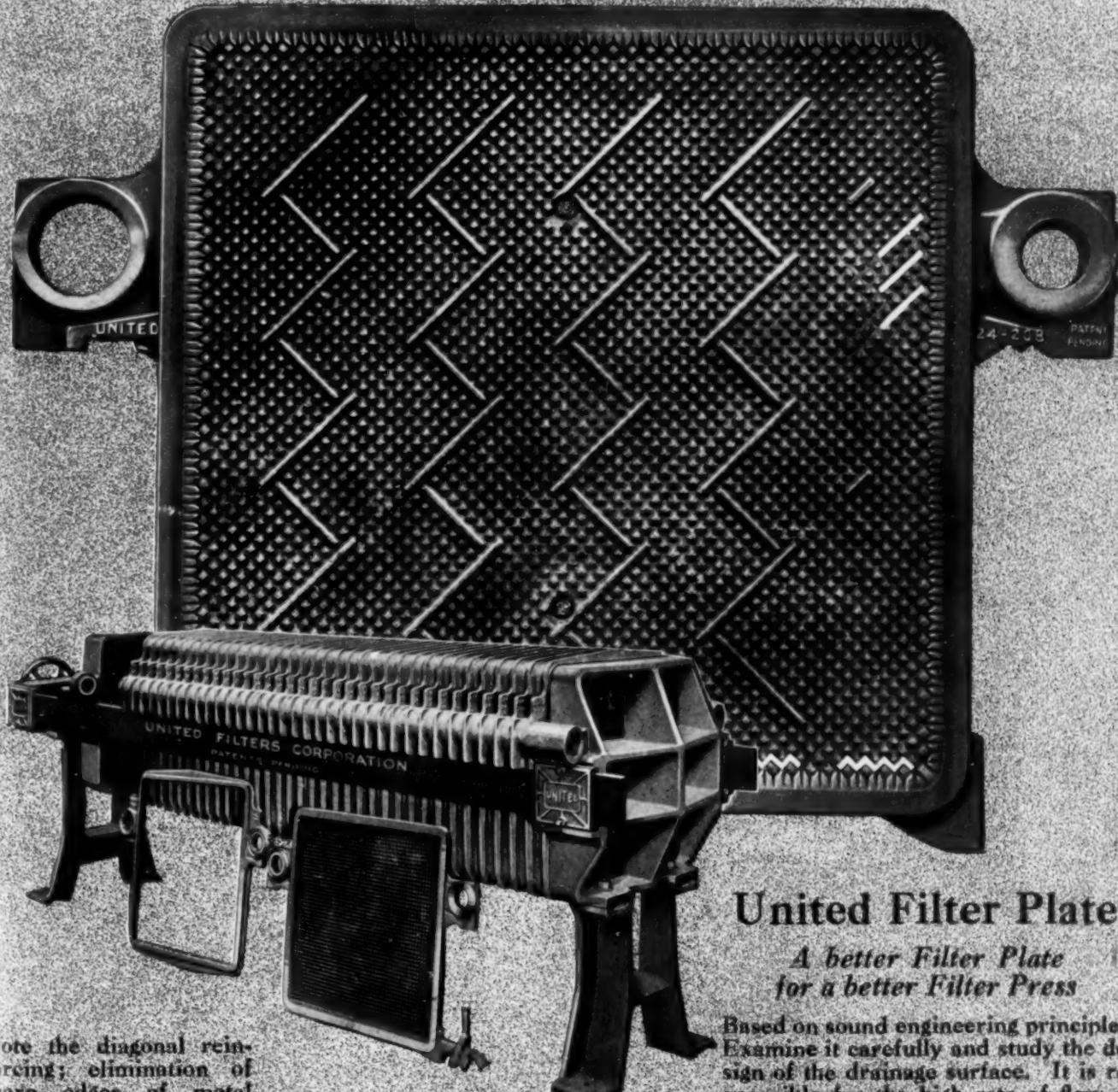


CHEMICAL & METALLURGICAL ENGINEERING

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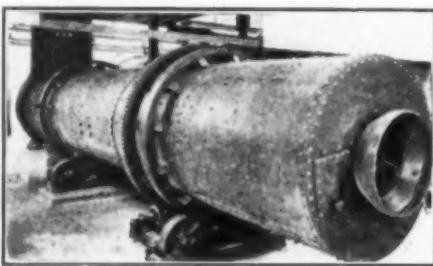


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Home Valuation Of Imports

THE framers of the new tariff are seriously considering the advisability of assessing ad valorem duties on American rather than foreign valuation. Although a radical departure from present practice, the proposal is generally looked upon with favor as a practical solution of the difficulties arising out of undervaluation, the chaotic condition of foreign exchange and the widely different production costs in this country and abroad. The foreign market value has been the basis for our ad valorem duties for practically a century and naturally the Government officials are reluctant to sanction a change which might upset the existing routine of customs administration.

It is pointed out, however, that there are many serious objections to our present system. The difficulties in obtaining foreign costs have made it necessary to rely more and more on the purchase price as stated in the importer's invoice. The differences in the costs of production in the various foreign countries have caused the assessment of different duties on the same article when imported from a number of sources. This, it is held, is a discrimination against countries in which costs are high and at the same time a direct concession to the foreign producer with low costs, from whom the domestic manufacturer is most desirous of being protected.

A concrete instance was brought to the attention of the Ways and Means Committee not long ago by HENRY HOWARD, the representative of the Manufacturing Chemists Association. He stated that a certain medicinal of German manufacture was being offered in the United States for 68 cents per pound on which a duty of 25 per cent ad valorem had been paid. This would indicate that the selling price in Germany was in the neighborhood of 55 cents, while at the same time the article was selling in England for \$1.50 per pound. Our duty on the British product would amount to 37.5 cents, or practically three times that imposed on the German. Another objection results from the difference in many countries between consumption and export prices.

Under the existing law duties are assessed on the "actual market value and wholesale price of the merchandise at the time of exportation to the United States, in the principal markets of the country whence the same has been imported" notwithstanding the fact that the imported goods are often purchased at substantially higher export prices.

These objections would be met in a large measure by the adoption of American valuation. In the first place, the value on which the duty is to be assessed would be determined in this country, where our Government has jurisdiction and ample authority, if need be, to compel

the disclosure of the necessary information. Second, under the American valuation plan, all countries would be on a parity with respect to the duties paid. It is claimed that the ultimate consumer will not be burdened through its operation, because in the United States the prices demanded by the high-cost countries operate to fix the prices and the low-cost countries are directly benefited. An indirect advantage, which was pointed out by Mr. HOOVER in his recent testimony before the committee, is that data obtained in the administration of home valuation can be put to the direct benefit of the public by utilizing the information for more accurate indexes of price movements.

Opposition to home valuation has come principally from importing interests which realize that its adoption will tend materially to increase the general level, that is, the amount of ad valorem duties. Others have opposed the plan because of the difficulties in its administration. If the principle is adopted it must be decided whether values are to be fixed at the port of importation or in the principal market or markets of the country, whether the time for appraisement is to be the date of the exportation or of the importation, and finally and what is perhaps of most importance, whether the values determined are to be the prices of imported merchandise or of similar or identical American products.

The action of the Congress will be awaited with interest, for the plan of home valuation, if adopted, must largely depend for its success on the solution of these administrative problems.

Madame Curie Honored By New York Chemists

THE luncheon by the chemists of New York to Mme. CURIE was a very distinguished affair. There were upward of 600 persons present, and it had the quality of an important social event. OSCAR, the *maitre d'hôtel* of the Waldorf-Astoria, had a special conference with the chef, who, for the love of France, gave the preparation his most particular attention, and Dr. EDGAR FAHS SMITH presided. That should be enough to satisfy any potentate! There were four speeches, every one to the point, and every one of the sort that made those present wish for more. Dean PEGRAM of Columbia spoke as a physicist, Dr. MOORE of the Bureau of Mines spoke as a chemist, and Dr. WOOD of the Crocker Cancer Research Institute at Columbia spoke as a physician. Dr. SMITH's introduction was a prose poem, and in conclusion when he introduced the Queen of Science and the musicians played the Polish national anthem it was just a little emotional. Mme. CURIE has been the recipient of many honors since her arrival on our shores, but none, we opine, has been more distinguished and delightful than this.

Occupational Diseases in The Chemical Industries

AT THE Rochester meeting of the American Chemical Society Prof. CHARLES BASKERVILLE of New York presented his report as chairman of the committee on occupational diseases. It contained a great deal of instructive information and was characteristic of all work undertaken by Dr. BASKERVILLE in that it was thorough, well arranged and competently prepared.

The reduction of occupational diseases in the chemical industries during the past year has been due chiefly to the decline in business. Fewer men have been employed. Then, too, the rush and disorder of war time were especially provocative of neglect of details that under ordinary conditions would be severely criticized. For this reason it is noticeable that complaints against chemical works as causing nuisance or injury increased materially as soon as the Armistice was signed. It is recorded, however, that there has been a distinct improvement on the part of chemical manufacturers to safeguard and protect their workers.

The change in the name of methyl alcohol to methanol has been largely adopted, and the committee believes this has had a decided effect in decreasing its use as a beverage. To the uncultivated lay mind alcohol is alcohol, no matter what its front name may be, and when the possessor of such a lay mind wants a drink any old alcohol will do. There occurred lately an incident that bears this out. A miner entered an apothecary's establishment in western Pennsylvania and called for a certain bath alcohol that is advertised as efficacious for the purpose specified, but not to be taken internally. The apothecary asked the miner what he wanted it for. "I want it to drink," he replied, and the apothecary refused to sell it to him. Now the miner had a real thirst, and he knew better; he was going to beat this prohibition business anyway. So shortly afterward a tramp came in with the price to pay for a bottle of the same stuff, and he explained that he wanted to rub it on his knee, which he had sprained. He effected the purchase and, once outside the store, he handed it over to the miner, who immediately pulled the cork and took a grand swig at it. He was really thirsty. But in less than three minutes' time that miner was doubled up over a fence and in the throes of repentance. The denaturant was not deadly; for a time the miner wished it was; but it was only painful. A citizen of that type would not hesitate to drink methyl or propyl or butyl or any other alcohol so long as it bears the alcohol label; on the other hand he would not think of drinking methanol, because that is merely a chemical.

Gas masks are coming into use in industries, but the canisters must be prepared with special adsorbents, depending on the objectionable material present in the air. In some Mexican oil camps gases have killed men and mules and the ordinary gas masks prove useless. The principal trouble was caused by the H₂S, and the difficulty was met by the employment of helmets like those used by divers. There was trouble, however, in inducing the men to wear them.

Tuberculosis appears to be practically non-existent among workers in sulphur dioxide.

Skin troubles were observed to follow wearing khaki cloth produced by certain factories. It is suggested that the presence of some unchanged dinitrobenzene may have caused the trouble, which was met by washing the consequent eczema with a 2 per cent phenol solution.

A disease called "the purples" has been attributed to benzene fumes. This decreases the volume of white corpuscles in the blood so as to destroy the power of coagulation. The patient then bleeds from the mucous membrane and bleeds beneath the skin until death results.

An excellent emollient to protect the skin of users of dope and varnish is recorded taken from Circular 91, Educational Bureau, Paint Manufacturers' Association and National Varnish Manufacturers' Association in the U. S. It consists of lanolin, petralatum, stearine and glycerine in equal parts by weight, and its use is recommended before starting to work and at the end of a shift, especially when coating compositions containing large amounts of organic solvents or thinners are used. In an important report by Dr. G. A. WELSH, medical officer to H. M. Factory at Gretna, picric acid is recommended as a dressing for acid burns.

In conclusion Dr. BASKERVILLE reported that with the assistance of W. H. PEARCE, librarian of the chemistry department of the College of the City of New York, abstracts of the current literature are now being compiled and that this matter will be available to members of the American Chemical Society.

Suggesting an Exhibit for The American Ceramic Society

IN AN article on "The Condition and Prospects of the British Ceramic Industry," by J. A. AUDLEY, published Jan. 31 in the *Journal of the Society of Chemical Industry*, the author says:

"There is still a demand for fancy goods, but not for inferior yet expensive ware which may be ranged in that class. As the world shortage of supplies gradually becomes satisfied and as international trade relations with Russia, Germany and other countries get restored, the vegetable and mineral exports from those places will have a powerful effect on the prices of similar commodities in America. This in turn will affect the prices of pottery, etc., purchased in America, from this country and elsewhere. It would therefore be wise for manufacturers . . . to concentrate their efforts on lines that are likely to be in continual demand, avoiding particular articles which will not be able to compete with cheaper, similar goods from other countries."

This advice to concentrate on quality in salable goods is sound, but salable goods is a broad term. Generally speaking, however, it means not only durable wares but those that are conceived and designed and wrought in good taste. It is quality that fixes good prices at first, after economic conditions are stabilized, and then, when industry at large meets the problem of quality, it is design which brings good prices and leadership in the market.

We venture the belief that American ceramic manufacturers can take time by the forelock in this respect, and make a step in advance of all others by a little judicious planning. Whether the industry is sufficiently developed here to have a great annual exposition or not we do not pretend to say, but we think it is. It might be initiated in connection with the meetings of the American Ceramic Society, just as the exhibits of the Steel Treaters and Foundrymen are arranged.

In the matter of design, so far as tableware and ornaments are concerned, we suggest that it would be wise to step out of the beaten track a little. The crockery and department store buyers think they know what they can sell and what has the reputation of being in

fashion, but that does not bring ideas into the business. Buyers are among the least imaginative of citizens. So we have a proposition to make; one that may be useless under present conditions, but our mind is open in this respect somewhat in the Scotch sense. We believe the National Academy, co-operating with the Art Division of the American Ceramic Society, would willingly appoint a jury of sculptors and painters to pass on the design of tableware and the like, and to award prizes for the best of each class. Then all such material as had been approved would have a certain *cachet*; it would be known to be in good taste. The exhibit should be broad in scope and include tapestry and face brick, art tiles, faience and all branches of ceramic industry in which expression of good taste in form and color make appeal to those who have the capacity to enjoy it.

Of course it is true that uncultured persons often have the most reprehensible likings and they buy dreadful stuff. The less we know the more certain we are, usually, that we possess that elusive quality which is the very gospel of culture. But most of us, no matter how ignorant we are, are rather sensitive in this respect, and we do not like to be classed among the ignorant. We like to have it said of us that we appreciate the right thing. The prize plates and dishes and also those that are approved would have in this approval a kind of good taste insurance. It might cost considerable for publicity to spread the idea abroad that wares approved by a jury of the National Academy of Design were being made and sold, but we think it would take with the public. The ambition for good taste and culture is so keen as to be no less than pathetic among our people. This would be a way to meet that desire and to get the market.

Science

Vs. Politics

TO UNDERTAKE to compete for the interest of the national professional politician by means of science might at first thought seem foolhardy. Yet science, or more particularly chemistry, is in real need of attention by our national legislators and it appears to be getting increasing attention, consideration and support.

One of the most encouraging signs of this development is the fact that the National Research Council was able to present in the Caucus Room of the Office Building of the House of Representatives the exhibit which has been on display for a short time in the headquarters of the Council. It is a most striking display of the relationship among fundamental science, chemical technology and important industrial developments of our nation. It touches upon problems of the dye industry, explosives manufacture, chemical warfare, nitrogen fixation, coking and byproducts and numerous other related and interrelated industries.

To set forth such an idea before our national legislators in their own office building is particularly fortunate. Perhaps as a result of this the Congressman may feel more at home with and realize more clearly his responsibility to the problems of chemical legislation which confront him. That he has afforded temporary relief to our chemical industries through the Knox amendment on the emergency tariff legislation is not enough, fine as that support may be. There still remain large and pressing questions for answer. It is well that a demonstration of some phases of this large problem can be brought so conveniently before him.

Inconsistencies in Prices and Wages

WE ARE in the midst of an industrial depression and we are all anxious to see the way out. We have had other industrial depressions, many of them, in the United States, and we have always got out. Not a few books have been written about industrial depressions, and in their historical sections they generally undertake to show the cause of each depression and the cause of its ending. Usually the explanation appeals to the reader. Those who have personal recollection of industrial depressions have a different conception from that presented by the books. Their recollection is that while during a depression the causes thereof were perhaps correctly assigned, the influences that should be expected to end them were not clearly seen. The industrial prophets would tell the public how and when the patient was going to get well. The patient would get well but the causes of his getting well would prove different from those mentioned in the predictions.

It is now being said in some quarters that the present industrial depression is different from those of the past in that now men know precisely what they are waiting for. This may be true and it may not be true, but it is certain that men think they know. They assert and believe that they are waiting for lower commodity prices and lower wage costs, the latter item involving both the rate of payment per day or week and the quantity of service rendered in the day or week.

Assuming then that we are in the midst of a readjustment in prices and wages the completion of which will bring industrial activity and prosperity, the notable phenomenon today is the inconsistency between prices of different commodities and between wage rates for different classes of employment. We see common labor in the iron and steel industry paid as low as 30 or 33 cents an hour, in some cases without overtime payment for hours in excess of eight in the day, against 46 cents an hour in 1920 with time and a half for hours in excess of eight, while we see the artisans in the building trades in many communities demanding wages substantially as high as those paid in 1920 and generally ranging above a dollar an hour.

As to prices, the monthly presentments of the Bureau of Labor Statistics at Washington are presumably authoritative. The weighting of the various commodities to form an index number of "all commodities" at wholesale is partly a matter of judgment, and that need not concern us in this connection. The April index number, just announced, is 154, the 1913 average being 100. It is the inconsistencies between the groups of commodities that are pertinent to the present argument. With 1913 as 100 we have for last month:

Farm products	115
Food, etc.	141
Cloths and clothing.....	186
Fuel and lighting.....	199
Metals and metal products.....	138
Building materials	203
Chemicals and drugs.....	168
Housefurnishing goods	274
Miscellaneous	154
All commodities	154

The people are faced with the condition that housefurnishing goods are 274 while farm products are 115, and that building materials are 203 while metals and metal products are 138. The public is puzzled. Those of the public who are farmers are indisposed to buy at 203 or 274 when they have to sell at 115. The need for readjustment is more pressing than ever.

Readers' Views and Comments

Melting Non-Ferrous Metals

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your March 23 issue M. A. Combs writes a very illuminating article upon the use of gas as fuel in furnaces for melting non-ferrous metals. In this article Mr. Combs, to his own satisfaction, neatly disposes of coke-, coal-, oil- or electrically-heated furnaces for the purpose mentioned, but the figures which he gives were obviously either selected for the purpose in hand or Mr. Combs was unfortunate, or fortunate, depending upon the viewpoint, in obtaining figures from plants employing very poor practice.

Mr. Combs states that "a furnace of 1,000-lb. capacity is used with gas as a fuel in foundries for red and yellow brass in smelting with wonderful results," then goes on to state that such a furnace required forty-two minutes to melt 1,100 lb. of metal, burning 310 cu.ft. of gas per 100 lb., which, figured at \$1.20 per 1,000 cu.ft., costs 37.2c. Also that on yellow brass, using such a furnace, the dross amounted to 3.74 per cent.

By comparison it is interesting to note that in a half dozen plants with which the writer is familiar, using electric furnaces, 2,000-lb. charges of a similar alloy are melted in less than forty minutes with a metallic loss less than 1 per cent and a cost for electric power less than 17c. per 100 lb. of metal melted.

Mr. Combs' statement is noted that in "comparing gas against electricity for melting furnaces the most striking advantage of gas after its economy is the flexibility of the furnace." The writer is familiar with a certain electric furnace installation in which one 2,000-lb. furnace has been used for melting pure copper, brass and bronze alloys, aluminum bronze and gray iron. It is not, however, contended that this wide diversity of alloys could be melted without a change in the refractory lining and I believe that any metallurgist or practical foundryman will readily agree that it would be suicidal to attempt to melt any difficult composition of copper or aluminum alloy on the same hearth as had previously been employed for melting high-lead or high-zinc alloys.

Herewith is offered a melting-cost-sheet taken from the books of a large manufacturer of brass and bronze castings using two rocking electric furnaces for the past thirty months:

STATEMENT OF ACTUAL MELTING COST

(As submitted by a manufacturing company using rocking electric furnaces during 1919-1920)

Alloy melted: 85 per cent copper, 5 per cent tin, 5 per cent lead, 5 per cent zinc	Cost per Ton
Power: 280 kw.-hr. per ton of metal melted at 1½c. per kw.-hr.....	\$4.20
Electrodes: 3½ lb. per ton at 25c. per lb.....	.88
Linings: 1,000 heats at \$200.....	.20
Labor: One man at \$6 per day.....	\$6.00
½ man at \$5 per day.....	2.50
	\$8.50
\$8.50 over 6 tons.....	1.42
Incidentals: General maintenance, supplies, etc.....	.50
	\$7.20
Metal loss: 0.5 per cent, or 10 lb. per ton at 20c. per lb.....	2.00
Total melting cost per ton, 2,000 lb.....	\$9.20
Total melting cost per cwt.....	\$0.46

It will be noted that the total cost of melting the alloy shown is 46c. per cwt., which I believe shows sufficient saving over the figures given by Mr. Combs for coal, oil or gas to prove conclusively that the users of

the furnaces which he discusses should immediately take steps, as so many modern industrial plants are doing, to replace their present extravagant melting equipment with the electric furnace.

E. L. CROSBY.

Detroit, Mich.

Effect of Manganese on Malleable Iron

To the Editor of Chemical & Metallurgical Engineering

SIR:—A few words of comment regarding the subject matter of Dr. Leuenberger's article on the effect of manganese on malleable iron, abstracted on page 751 of your issue for April 27, seem worth while.

The abstractor seems to have lost sight of the fact that the work bears no direct relation to the properties of malleable cast iron as made in this country. Both the original German article and your abstract indicate this quite clearly, although the evidence is probably not obvious to those not intimately acquainted with American malleable cast iron.

The table of analyses indicates carbon contents which would under American conditions of annealing result in extremely low tensile strengths. Furthermore, under these annealing conditions, which depend upon the separation of the carbon in the free state and not on its removal, the physical properties of the resultant product would be infinitely more affected by the variations in carbon content than by any moderate variations in manganese. Thus iron with an original carbon content of 3.18 would have a tensile strength of perhaps 38,000 to 40,000 lb. per sq.in., and iron with a carbon content of 2.6 would have a tensile strength of possibly 48,000 lb. per sq.in.

The silicon values quoted are so low that a graphitizing anneal would be practically prevented. The sulphur values are approximately in line with American practice, but both the physical properties and the extremely energetic heat-treatment by which these properties are attained indicate that the annealing has been done by decarburizing and not by graphitizing.

With the American graphitizing anneal those irons having a manganese content of 0.66 and above in the investigator's table would hardly have shown any ductility at all. In fact the results would have been approximately as indicated in the data for the first heat-treatment reported upon. The fact that the ductility increased with subsequent heat-treatments and the strength decreased is an evidence of the further removal of the continued carbon by oxidation. This letter is, therefore, prompted by a desire to point out that those interested in American malleable cast iron should not rashly apply Leuenberger's data to American conditions, as in that manner untold confusion and no useful improvement would result. This confusion between the American and the European practice has already been a source of much vexation in this country, and a further obscuring of the matter is much to be deplored.

May I refer to a series of articles now appearing in the *Iron Trade Review* on American malleable cast iron for a more extended discussion of the difference in principles and practice between American and European malleable plants?

H. A. SCHWARTZ,
Manager of Research,
National Malleable Castings Co.

Cleveland, Ohio.

F. M. Feiker to Join Department of Commerce

F. M. FEIKER, vice-president and chairman of the editorial board of the McGraw-Hill Co., has been appointed assistant to the Secretary of Commerce, with duties and relations of greatest significance to business publications.

Briefly Mr. Hoover has divided the bureaus of the Department of Commerce into two parts. Assistant Secretary Huston will supervise the bureaus relating to navigation and fisheries, while Mr. Hoover will give his personal attention to the bureaus of Foreign and Domestic Commerce, Standards and Census. Mr. Feiker will directly assist Mr. Hoover in the expansion of these bureaus as aids to business.

The immediate problem is to find out what kind of facts and figures industry needs from the Government by means of a series of conferences with the representative men of industry. Having organized the department to function according to the requirements, the next problem is to devise an adequate system of clearing the collected data back to business. It will be apparent at once that with Mr. Feiker's background of engineering training, his viewpoint on the needs of industry and his sense of publicity, he will be in a position to render unusual service in the furtherance of Mr. Hoover's plans.

It is Mr. Hoover's purpose to develop the Department of Commerce so that it will have the same relation to business that the Department of Agriculture now has to the farmer. In other words, he feels that its function is to aid industry, not to regulate or control it. Considering his intimate knowledge of foreign conditions, his masterful grasp of economic principles, and his present official position, a most optimistic view of the developments in prospect is justifiable.

It is well known to those who have been close to the Department of Commerce that Mr. Hoover has been looking all over the country to find a man suitable for the work he has in mind. The invitation, which came to Mr. Feiker first over the long-distance telephone from Washington, was a distinct surprise. The full importance of the position and the opportunities which it offers were not made clear until Mr. Feiker had an opportunity to have a full discussion of the proposed work with Mr. Hoover. It is significant that Mr. Hoover has a keen appreciation of the fundamental service rendered by the business press. Considering the fact that he is the first engineer to have a place in the Cabinet or the Department of Commerce, it is evident that engi-

neers and engineering thought are destined to play a more important part in the business of the country than ever before. Many other developments are making clear that the engineer is taking a new place in the world and industry.

Mr. Feiker is a graduate in electrical engineering of the Worcester (Mass.) Polytechnic Institute, class of 1904. Following his graduation he assisted in special research work in high-tension transmission and generation at Worcester. From 1906 to 1907 he served the General Electric Co. at Schenectady, N. Y., as technical journalist, and in the latter year went with the *System* magazine at Chicago, shortly afterward developing the idea of *Factory* magazine, of which he became managing editor. In 1912 he was appointed chairman of the editorial board of all the A. W. Shaw publications. He left Chicago in 1915 to join the McGraw organization in New York as editor of *Electrical World*. In the year following he established *Electrical Merchandising*, to supplement and extend the service of *Electrical World* to the industry. In 1919 he was made editorial director of the McGraw-Hill Co., and in January, 1920, was elected vice-president and chairman of the board of editors of its eleven publications.

Mr. Feiker is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Association of Engineers, the National Electric Light Association, the Illuminating Engineering Society and other technical societies, and is prominent in the committee work of these associations. During 1920 he served as chairman of the Editorial Conference of the New York Business Publishers Association. He is a member of the Engineers' Club of New York, the City Club, the University Club of Chicago and the Cosmos Club.

Mr. Feiker will not sever his connection with the McGraw-Hill Co., but will be given an indefinite leave of absence.

In a statement of the purposes of his new work, Mr. Feiker said: "I hope to be able to assist Mr. Hoover in the development of the statistical and research branches of the Government in such a way as to provide information and help for the needs of the average business man and the small manufacturer who have neither the opportunity nor the capital to get the information individually. The Government's functions in the collection of fundamental data and trade information can be put to their service in a definite and practical way. I am keenly interested in Mr. Hoover's broad plans to develop the Department as an aid to industry."



FRED M. FEIKER

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Bureau of Mines Cryogenic Laboratory Dedication

THE new Cryogenic Laboratory of the U. S. Bureau of Mines was dedicated by Mme. Curie as a part of the celebration of the visit of this famous scientist to Washington. Addresses were delivered upon this occasion by Secretary Fall, the Director of the Bureau and Dr. R. B. Moore, chief chemist, in charge of the laboratory. Mme. Curie, in addition to delivering the dedicatory address, also pressed the button which set in motion the machinery for the first formal operation of the equipment in the new laboratory. Participating in the affair were the Mme. Curie Reception Committee of Washington, various Government officials and representatives of the Army, Navy and scientific departments of the federal establishments interested.

The new laboratory, which is to be operated under the appropriations of the military departments by allotment by the Helium Board, is to take up the work required for determination of scientific data of fundamental interest, especially in connection with the operation of Government helium plants. The earlier history of this work and the description of the new laboratory equipment is given by the bureau in the following language.

NEED FOR THE RESEARCH LABORATORY

When the helium plants were started in 1918, owing to the pressure in connection with all war undertakings there was no time nor opportunity to do any research work on a small or semi-commercial scale. It was necessary to design and build the plants as rapidly as possible and to do whatever experimentation was required in the plants themselves. Shortly after the two experimental units at Fort Worth were operating, the advisability of research work in connection with the undertaking was plainly seen, and some vapor pressure work was started at the Bureau of Standards under a co-operative arrangement with the Bureau of Mines and the Army and Navy. Last year arrangements were made with Dr. Harvey N. Davis, of Harvard University, and Dr. F. G. Keyes, of Massachusetts Institute of Technology, to do further work along this line, and this is now in progress. There is, however, a distinct addition in having a thoroughly equipped laboratory which is available at all times for research work in connection with the plants and this has been accomplished through the establishment this year in the Bureau of Mines at Washington of a Cryogenic Laboratory. The funds were allotted to the Bureau of Mines last June through the interest of Commander A. K. Atkins, of the Navy, and Colonel C. DeF. Chandler and Lieutenant R. S. Olmstead, of the Army Air Service, and at the present time Lieutenant Commander S. M. Kraus and Major P. E. Van Nostrans are acting for the Navy and Army respectively under the co-operative agreement with the Bureau of Mines.

EQUIPMENT

The equipment is now installed in the new Department of Interior Building at Washington. It consists of two 4-stage Norwalk air compressors, rated at 75 cu.ft. of free air per min. each, compressed to 3,500 lb. per sq.in. at 135 r.p.m. These compressors are driven by two 50-hp. variable speed, 220-volt d.c. motors. These compressors will be used for making liquid air and for obtaining the necessary refrigeration for other purposes. From 15 to 20 liters per hour of liquid air can be obtained. In addition there is one three-stage submarine

type compressor, rated at 28.87 cu.ft. of free gas per min. at 150 r.p.m., compressed to 3,000 lb. per sq.in., and driven by a 15-hp. variable speed, 220-volt d.c. motor; also one three-stage submarine type compressor, rated at 16 cu.ft. of free gas per min. The first one will be used for liquefying hydrogen and the second for a liquid helium cycle. All the compressors have unloading valves so that the capacities can be varied within wide limits.

There are two 300-cu.ft. and one 200-cu.ft. gas holders for holding hydrogen and helium; four smaller holders for storing gas samples; a machine shop equipped with 13-in. engine lathe, bench lathe, shaper, two drill presses, grinders, pipe tools, etc. There are also available one Air Reduction low temperature expansion engine, air and hydrogen liquefiers, and the necessary physical and chemical apparatus to go with the above equipment.

The object of the laboratory is twofold. Its first and main object is to obtain scientific data that will be of use in the operation of the helium plants so as to get more efficient operation and reduce the cost of helium production. Its second and subsidiary use is to furnish facilities to a limited number of American scientists who may be interested in using the laboratory for special low-temperature work, particularly along lines that will not be covered by the technical men of the Bureau of Mines.

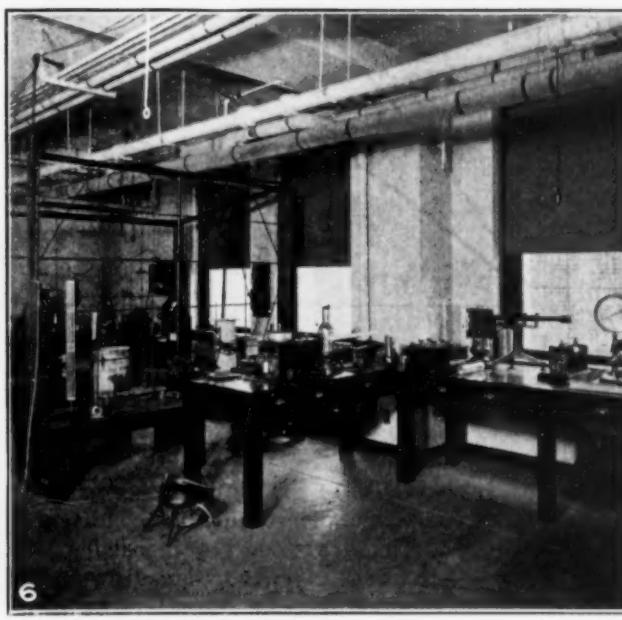
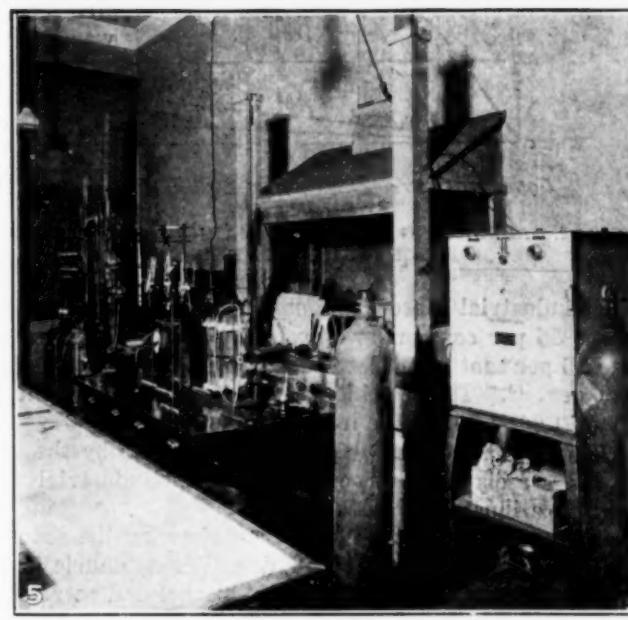
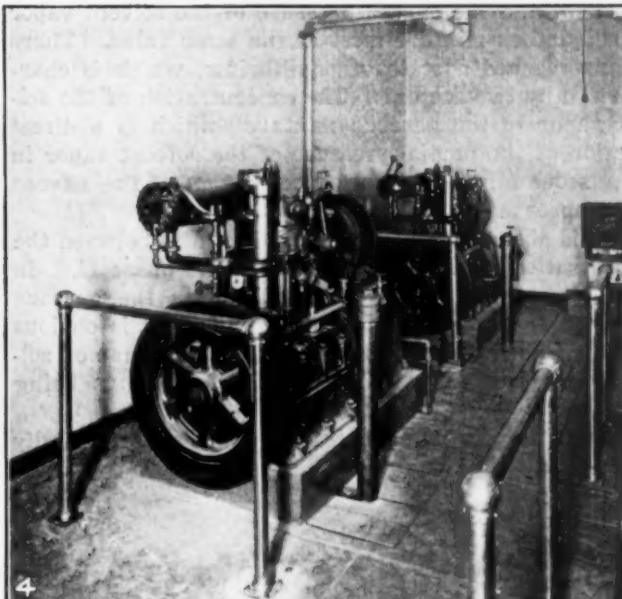
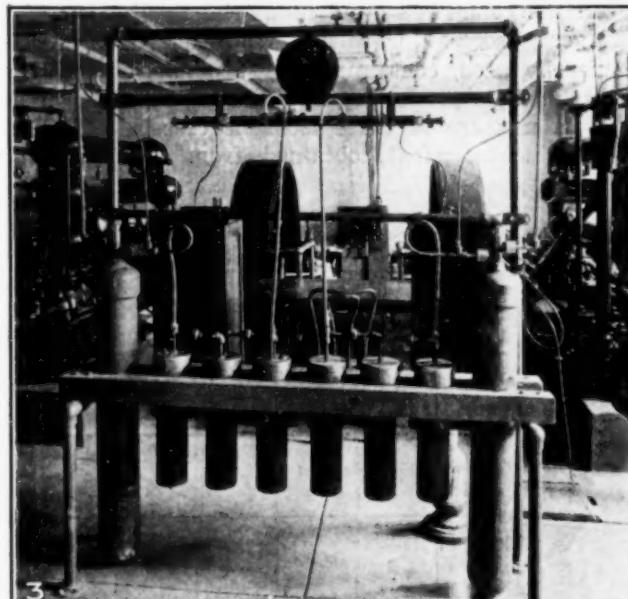
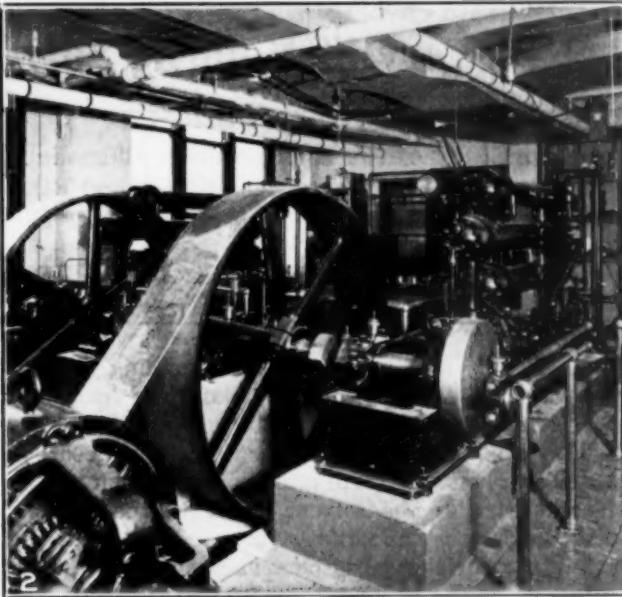
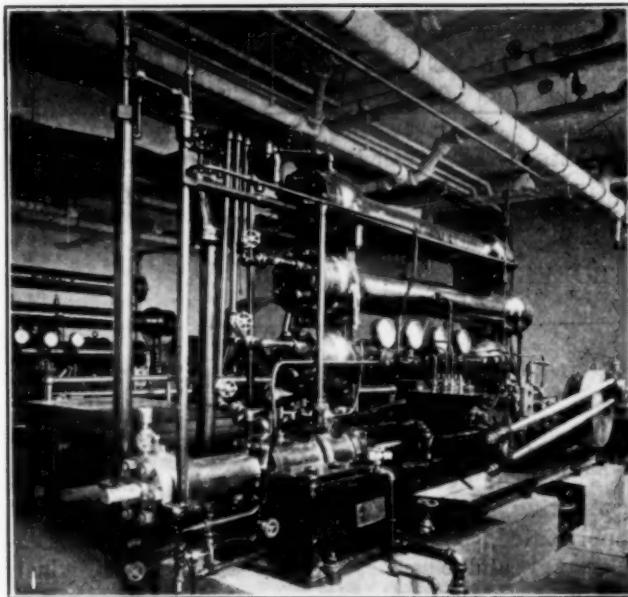
VAPOR PRESSURE STUDIES AND CHARCOAL PURIFIERS

At the present time the work that is being carried on is along two definite lines. First, vapor pressure work in connection with ternary mixtures, and second, in connection with the purification of helium by means of charcoal at low temperatures. It has been found that charcoal at low temperature has a selective action on nitrogen, absorbing this gas, but not absorbing helium, or at least to only a very small extent. This property has been adapted to purifying helium both from nitrogen and from air.

The Army has constructed a repurification outfit on two railroad cars. The first car contains the power plant, and the second car contains the compressors and refrigeration equipment. The Bureau of Mines has been asked to design and install a charcoal repurification unit on this car, and this work is now under way, the equipment being partly constructed in the Cryogenic Laboratory, and the whole will be tested out in this laboratory before installation in the car. If this work is a success it is probable that it will be of sufficient value to install in the production plants also in order to step up the cruder product which is obtained in the plants to 100 per cent helium, which can be obtained by means of the charcoal. The importance of having the higher product is exceedingly great, as a dirigible filled with 100 per cent helium rather than 94 per cent will have a much greater lifting power and also a wider range of operations.

PERSONNEL

This laboratory is under the direct charge of Dr. R. B. Moore, chief chemist of the Bureau of Mines, and the technical personnel consists of J. W. Davis, mechanical engineer, of Cornell University and the University of Illinois; C. W. Seibel, physical chemist, of the University of Kansas; Dr. A. G. Loomis, physical chemist, of the universities of Missouri and California; and Dr. L. Finkelstein, physical chemist, of the Armour Institute of Technology and the University of Chicago.



BUREAU OF MINES CRYOGENIC LABORATORY

Fig. 1. Air compressors.
 Fig. 3. High-pressure purifiers.
 Fig. 5. Chemical laboratory.

Fig. 2. Air compressors, showing motor drive.
 Fig. 4. Compressors for hydrogen and helium cycle.
 Fig. 6. Physicochemical laboratory.

Recovery of Volatile Solvents by the Bregeat Process

Descriptive Study of the Application of Phenolic Absorbents — Theoretical Considerations—Equilibrium Curves at 20 Deg. C. Between Cresol and Ether, Ethyl Alcohol, Methyl Alcohol, Acetone and Benzene—Influence of Water Dilution of Absorbent—Operation Data

BY M. ROULLEUX AND ROBERT G. DORT

WHEN a gaseous mixture containing solvent vapor is in contact, for a sufficient length of time, with a certain quantity of an absorbent in a closed vessel, the solvent vapor is partly absorbed from the gaseous mixture into the absorbent. The partial pressure of the solvent vapor in the gaseous mixture decreases, while the vapor pressure from the solvent in the enriched absorbent rises from zero up to the point where the vapor tension of the solvent in the absorbent and the partial pressure of the solvent vapor in the gaseous mixture meet at the same value. There is thus reached a state of equilibrium, which is characterized by two factors: The concentration of the solvent vapor in the gaseous mixture (which is a direct function of the partial pressure of the solvent vapor in the gaseous mixture), and concentration of the solvent in the absorbent.

A good absorbent must show a high ratio between the concentration of the solvent in the liquid phase (i.e., in the absorbent) and the concentration in the gaseous phase when the system is at equilibrium. It is obvious that the higher this ratio the lower the amount of solvent vapor remaining in the gas, other things being equal.

This ratio can be expressed in an experimentally

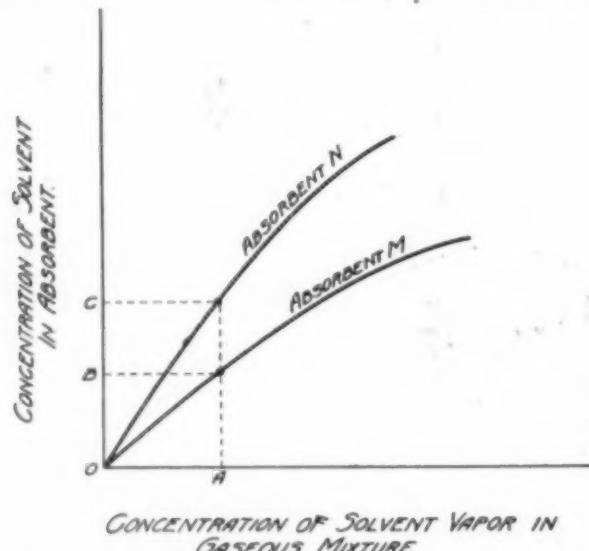


FIG. 1. GENERAL REPRESENTATION OF THE ABSORBING POWERS OF TWO ABSORBENTS

determined curve (see Fig. 1) giving one concentration as a function of the other under equilibrium conditions. For illustration, two arbitrary curves marked "Absorbent M" and "Absorbent N" have been drawn. If OA represents the concentration of solvent vapor in a particular gaseous mixture, then the highest possible concentrations of the solvents in Absorbents M and N are represented respectively by OB and OC. The ratio

OC : OB represents the superiority of Absorbent N over M so far as absorption is concerned.

ABSORPTION BY PHENOLIC ABSORBENTS

The advantage of employing as a liquid absorbent one consisting essentially of phenols was discovered, first appreciated, patented in France, the United States, Germany and elsewhere, and first put into industrial use by J. H. Bregeat.

In the commercial and industrial application of the Bregeat process for solvent recovery, crude cresol is generally used, containing, for example, about 97 per cent phenolic products. Such crude cresol is, in general, a mixture of three isomeric cresols, $C_6H_5CH_2OH$ (ortho, meta, para), obtained from coal distillation.

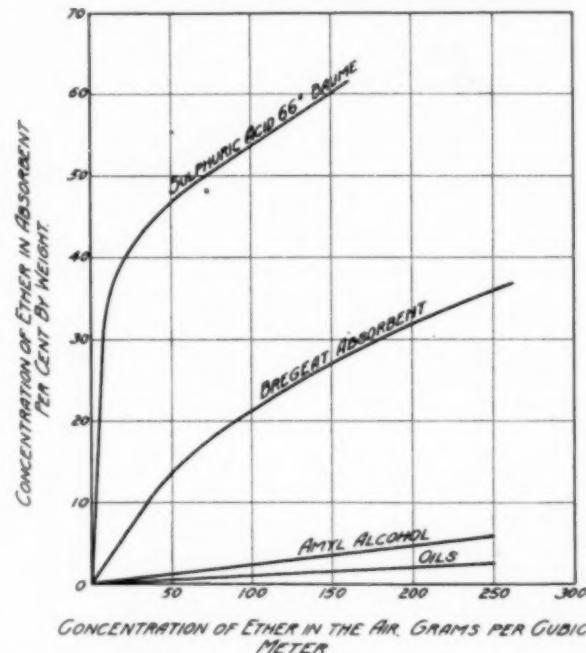


FIG. 2. ABSORBING POWER OF VARIOUS ABSORBENTS FOR ETHER AT 20 DEG. C.

The industrial absorbent employed usually contains about 35 per cent ortho cresol, 40 per cent meta cresol and 25 per cent para cresol, and distills between 190 and 220 deg. C. The specific gravity of this absorbent is about 1.04; the specific heat is about 0.6.

The concentrations which may be reached by the use of the cresols as absorbents for several industrial solvents are illustrated in the figures.

In Fig. 2 curves have been drawn showing the absorbing powers¹ for ether of 66 deg. Bé. sulphuric acid, Bregeat absorbent (cresols), amyl alcohol and petroleum

¹Copied from a report from the French "Ministère de la Guerre, 6^e Direction, Poudres" entitled "Etude Théorique sur Différents Procédés de Récupération des Vapeurs Ethero-Alcooliques en Atmosphère Diluée."

oils. (All curves are based on observations at 20 deg. C.) The seeming superiority of concentrated sulphuric acid as an ether absorbent is marked. This superiority is, however, only apparent and is negatived by numerous serious objections and industrial inconveniences, as will be briefly explained hereinafter. These curves for ether absorption show clearly the superiority of the cresols over amyl alcohol and oils as absorbing mediums. It might be added that the use of amyl alcohol is ruled out by its extremely toxic effect on the workmen and by its prohibitive price.

Fig. 3 shows the curve indicating the absorbing prop-

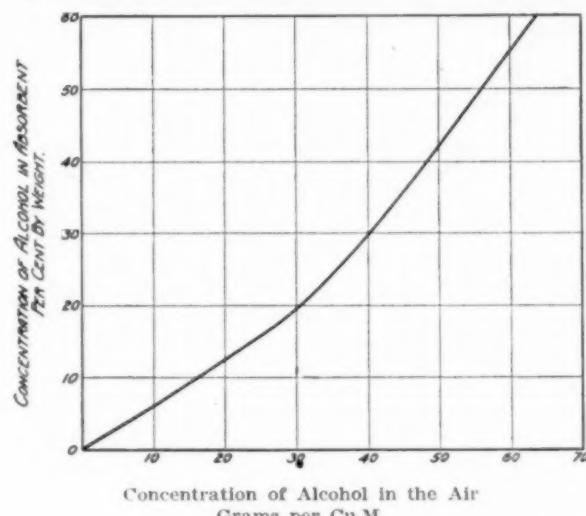


FIG. 3. ABSORBING POWER OF THE CRESOLS FOR ETHYL ALCOHOL

erties¹ of the cresols for ethyl alcohol. It will be noted that as the concentration of alcohol vapor in the gaseous mixture rises, the possible concentration of alcohol in the cresols rises very rapidly. It is proper to conclude that the cresols are very good absorbing media for ethyl alcohol.

Fig. 4 shows the curve for the absorption¹ of benzene by the cresols.

Fig. 5 represents curves showing the concentrations of such pyroligneous solvents as acetone and methyl alcohol in a gaseous mixture, and the possible concentration of these solvents in the cresols. This application will become important in the wood distillation (wood charcoal) industry.

It is of interest to note that the solvents represented in the curves represent a wide range of industry. Ether is used, for instance, in the manufacture of artificial silk and smokeless powder. Ethyl alcohol is used in the manufacture of artificial silk, gas mantles, artificial leather, celluloid, smokeless powder, and is probably lost in considerable amounts from the vats of fermentation plants. Benzene is used particularly in the manufacture of artificial leather and rubber goods; the possibilities of more complete recovery of benzene from coke-oven gas are large. Acetone and methyl alcohol are used, for instance, in the manufacture of films, airplane dopes, explosives and lacquers.

INDUSTRIAL ABSORPTION

In industrial practice the liquid absorbents have the important advantage of allowing the carrying out of the absorption on the countercurrent principle, in which both gaseous mixture and absorbent are made to flow in intimate contact with each other in opposite direc-

tions. By the use of this principle equilibrium between the concentrations of the solvent in the absorbent and in the gaseous mixture is no sooner approached than conditions are mechanically changed in such a way that further absorption is required in order to approach equilibrium again. That is to say, a certain particle of absorbent which has approached equilibrium with the gas surrounding it is being constantly and mechanically moved forward into a new gaseous mixture where the concentration of the solvent vapor therein is higher than in the previous position. As a result of this change the particle of absorbent must pick up more solvent vapor from the gaseous mixture before equilibrium is again approached. When the absorbent leaves the scrubbing apparatus the concentration of the solvent in the absorbent corresponds practically to the maximum obtainable from the gaseous mixture entering the apparatus, provided the scrubbers have been correctly designed. When the gas leaves the scrubbing apparatus it has just been in intimate contact with fresh absorbent, this resulting in the absorption from the gaseous mixture of practically the last traces of solvent vapors, again provided the scrubbing apparatus is correctly designed.

This results in the possibility of obtaining the highest possible concentration of the solvent in the absorbent, together with practically complete absorption. Moreover, this principle allows the reduction of the size of the scrubbing apparatus—i.e., the wetted surface of the scrubbers—to a minimum, other things equal.

Any liquid absorbent theoretically allows obtaining a complete absorption. It is only a question of using a sufficient flow of absorbent in a scrubbing apparatus of sufficient size. But a poor absorbent will lead to the use of a large flow of liquid together with large scrubbers, while a good absorbent allows the reduction of both absorbent flow and apparatus size. From this

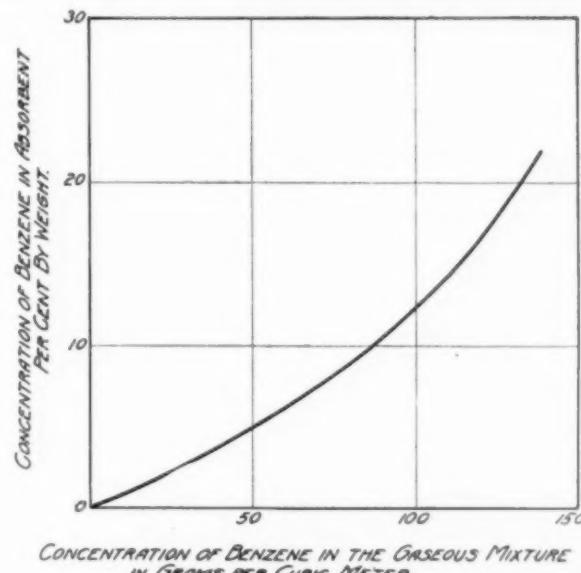


FIG. 4. ABSORBING POWER OF THE CRESOLS FOR BENZENE

point of view the cresol absorption curves (see Figs. 2, 3, 4 and 5) show the advantage of this absorbent, but they do not bring out any of the other advantages of the cresols as absorbents.

The importance of these other advantageous properties is emphasized by the disadvantageous properties of sulphuric acid. The absorbing power of sulphuric acid

for ether and alcohol (as shown in Fig. 2) has attracted many. But up to the present sulphuric acid has failed to prove a commercially good absorbing medium, because its high absorbing power is its only advantageous quality. All its other properties are constant sources of inconvenience. The industrial handling of a large quantity of sulphuric acid requires lead or lava containers, piping, scrubbers, etc. The absorbing power of sulphuric acid is greatly lowered by the presence of water in the air treated. Furthermore, after stripping, the previously diluted sulphuric acid must be reconcentrated, which also prevents the process from being continuous. The sulphuric acid process, moreover, does not always

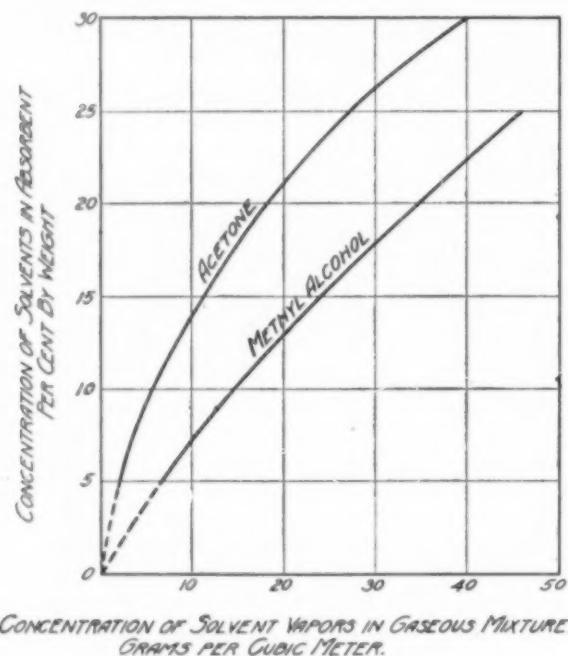


FIG. 5. ABSORBING POWER OF THE CRESOLS FOR ACETONE AND METHYL ALCOHOL

return the absorbed solvent in its original state—ether is partially transformed to alcohol, for example.

All this shows why the Bregeat process has always been able to establish its superiority over the sulphuric acid process whenever there has been a fair competition between them.

Besides its high absorbing power, the Bregeat absorbent has many other advantages, among which the following may be mentioned:

The cresols have no corrosive action whatsoever on the usual apparatus materials, such as steel, copper, brass and concrete.

Large variations in the concentration of the solvent vapors in the gaseous mixtures—a condition generally found in solvent recovery problems—do not affect the efficiency of the Bregeat absorbent; that is to say, there seems to be a distinct hysteresis effect in the evolution of solvent vapors from the cresols at ordinary temperatures and pressures (though this may be the case with other absorbents to a lesser degree). The reduction in the concentration of the solvent vapors in the cresols seems to follow only with a considerable lag the reduction in the concentration of the solvent vapors in the gaseous mixture above it. This means that when the Bregeat absorbent, concentrated to a certain point in solvent, comes into contact (always assuming normal temperature and pressure) with a gaseous mixture much less concentrated in solvent vapor than that which has

previously surrounded it, the cresylic absorbent does not at once attain equilibrium by losing, to a certain extent, its absorbed solvent.

This hysteresis (lag) effect would go some way toward explaining the remarkable success which the use of the Bregeat absorbent has had in treating gaseous mixtures, the concentration of which in solvent vapors varies very suddenly and through wide ranges. For instance, in one of the Bregeat industrial plants the concentration of ether alcohol in the gaseous mixture being scrubbed varied from zero to 50 g. per cubic meter within five-minute intervals, and sometimes more often. Fig. 6, which shows the varying concentration² of ether-alcohol vapor in the gaseous mixtures from presses manufacturing smokeless powder (Poudre "B"), illustrates clearly the type of gaseous mixtures which the Bregeat process handles very successfully.

The observation of this hysteresis effect supports the opinion that the absorption of various solvents by the cresols involves something more than mere solution. Some kind of a molecular association or complex, easily broken down by heat, seems to result. Full and accurate data on this point are still lacking. Certain indications, however, aside from the hysteresis effect, do seem to tend toward the idea that something more than simple solution takes place.

The cresols also have the important property of not being greatly affected by the absorption of water vapor. Under average plant conditions (humidity) the cresol will not absorb more than 2 per cent of water from the air. The small effect that this amount of water has upon the absorbent effect of cresol for ether, for instance, is shown³ in Fig. 7. In fact in industrial practice

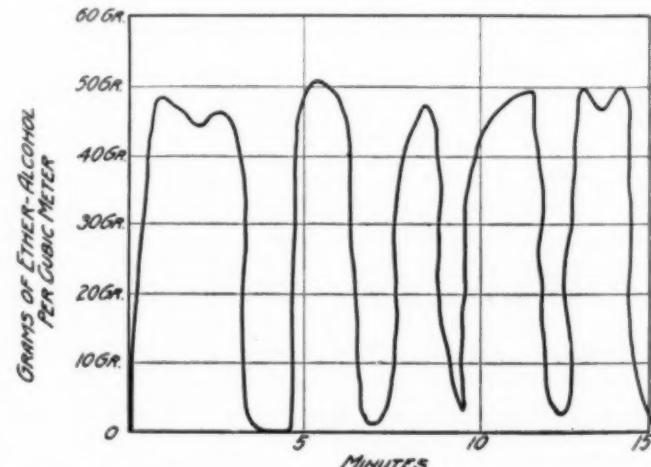


FIG. 6. CONCENTRATION OF ETHER-ALCOHOL IN GASEOUS MIXTURES ESCAPING FROM "B" POWDER PRESSES

small amounts of water are sometimes added to the cresols in order to create a condition which is very favorable for stripping.

The cresols are good absorbents for many different

²Copied from a report from the French "Ministère de la Guerre, 6^e Direction, Poudres" entitled "Etude Théorique sur Différents Procédés de Récupération des Vapeurs Ethero-Alcooliques en Atmosphère Diluée."

³In *J. Am. Chem. Soc.*, vol. 9, pp. 1949-1977 (September, 1917), in a paper by Messrs. Hatcher and Skirrow, dealing primarily with compounds of phenol and cresol with pyridine, it is stated (p. 1953) that when the molecular weight of ortho and para cresol dissolved in benzene is determined by the freezing point method, their molecular weights are found to be smaller than the formulas would indicate. In explanation of this phenomenon the authors state: "Possibly this may be due to combination with the solvent" (benzene). It is also stated in this paper that the same phenomenon has been observed by Amwers, (*Z. physik. Chem.*, vol. 12, p. 689, 1892).

substances used as solvents. This property is of utmost importance in those solvent recovery problems where several kinds of solvents are used simultaneously, successively or in different operations.

The vapor tension of cresol at ordinary temperatures is very low. This means that under average industrial conditions the gas leaving the scrubbers carries only a trace of cresol vapor.

The cresols easily lose their absorbed solvents when heated up to a temperature which never needs to be over 150 deg. C. This temperature is conveniently obtained by the use of steam, at 100-lb. pressure.

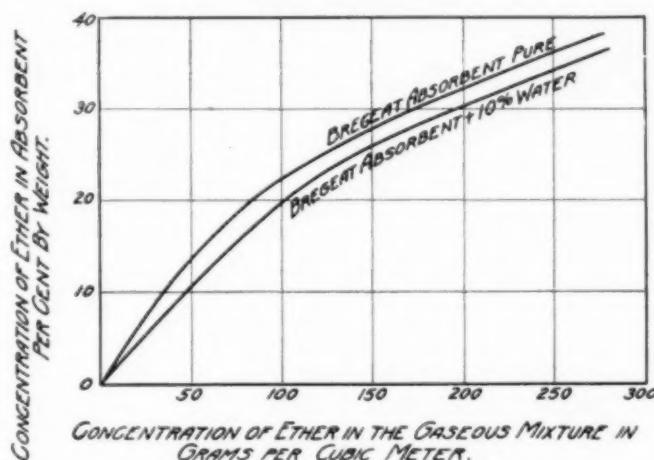


FIG. 7. INFLUENCE OF WATER UPON ABSORPTION

The Bregeat absorbent returns the solvents absorbed therein without alteration and in about the same proportion as that in which they were absorbed.

INDUSTRIAL APPLICATION

Besides the use of a new absorbent the Bregeat process involves the continuous operation of a very efficient apparatus. The Bregeat apparatus is, in many respects, similar to that employed in the debenzolization of coal gas. It (the Bregeat apparatus) has been designed for the employment of cresol to realize the special advantageous properties of this absorbent. In some cases where the solvents have to be separated from one another or from water (if one or more solvents are miscible therewith), the equipment is completed by a continuous rectification apparatus from which these solvents are automatically obtained in the desired state of purity. The types as well as the proportion of the various pieces of apparatus have been carefully studied in view of obtaining the maximum efficiency (percentage recovered) together with the minimum first cost and minimum operation cost.

The general operation of a Bregeat installation is shown schematically in Fig. 8. This diagram is typical of the system, although conditions in each individual installation govern the design of the scrubbing apparatus, and to a greater extent that of the rectification apparatus. In detail, the Bregeat process, as represented in Fig. 8, is as follows:

COURSE OF THE AIR-SOLVENT VAPOR MIXTURE

The course of the air-solvent vapor mixture is indicated on Fig. 8 by arrows with dotted shafts. The air-solvent vapor mixture enters the system at the base of the second scrubber, rises through this scrubber, meeting the descending absorbent. From the top of the second scrubber the air-solvent vapor mixture goes to the bottom of the first scrubber, rises through this, meeting the descending fresh absorbent. From the top of the first scrubber the air, now deprived of all solvent vapors, is discharged into the atmosphere.

COURSE OF THE ABSORBENT IN THE SCRUBBERS

The course of the absorbing liquid is indicated in Fig. 8 by arrows with solid shafts. The absorbent stored in the absorbent storage tank marked "Fresh Absorbing Liquid" is pumped to the top of the first scrubber, where it descends, meeting the rising air-solvent vapor mixture already partly deprived of its solvent vapor by scrubbing in the second scrubber. From the bottom of the first scrubber the absorbent is taken to a pump, whence it is raised to the top of the second scrubber. In this scrubber the gaseous mixture containing the solvent vapors is met by the down-flowing absorbent as in the first scrubber.

COURSE OF THE ABSORBENT IN THE STRIPPING APPARATUS

From the bottom of the second scrubber the absorbent, now containing the solvent, is raised by a pump to the regulating tank. (This regulating tank is connected with a pipe marked "Overflow" through a pipe line leading to the absorbing liquid tank. This is only for use should some stoppage occur in the absorbent line beyond the regulating tank.) From the regulating tank the absorbent goes to the heat exchanger, where it is partly

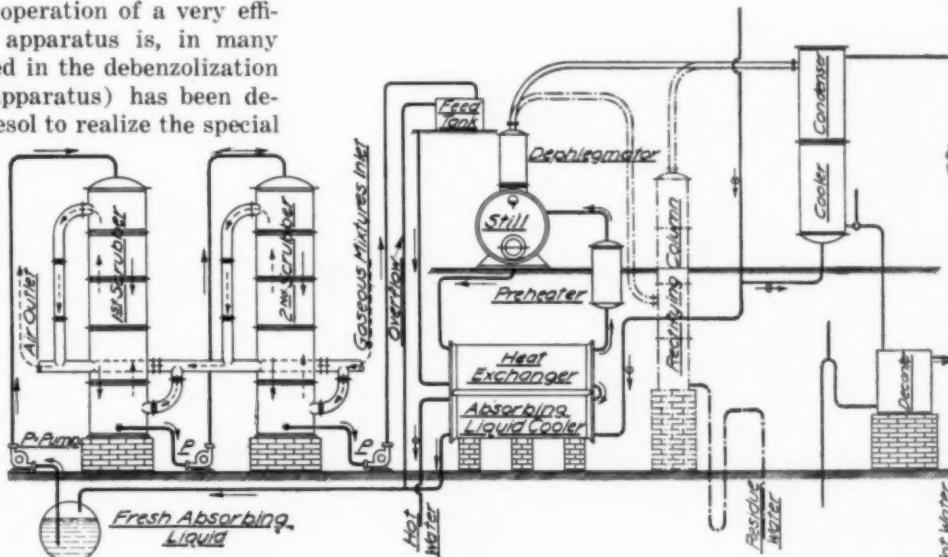


FIG. 8. FLOW SHEET OF THE BREGEAT SOLVENT RECOVERY SYSTEM

heated by hot absorbent coming from the stripping still. From the heat exchanger the absorbent goes to the preheater, where it is heated to about 150 deg. C. by steam coils. From the preheater the absorbent goes to the stripping still (marked "Still" on Fig. 8), where it is heated further. The solvent vapors are driven off from the absorbent here. The absorbent, now freed of solvent vapors, and hot, flows down through the heat exchanger, where it heats the cool, fresh incoming

absorbent. From the heat exchanger the partly cooled absorbent goes to the "Absorbing Liquid Cooler," where it is cooled to about room temperature and thence it flows to the absorbent storage tank.

COURSE OF THE SOLVENT VAPOR STRIPPED FROM THE ABSORBENT

From the stripping still the solvent vapors go to the dephlegmator, where a certain amount of separation and rectification takes place. From the dephlegmator the solvent vapors go either to a continuous rectifying column—if the solvent is miscible with water or if there are several solvents to separate from one another—or to a condenser, then to a cooler, and then to a decanter, if the solvent is not miscible with water. If a rectifying column is used, the vapors from the rectifying column pass into the condenser, whence their course is the same as in the case of the solvents condensed without rectification.

Temperature- and pressure-recording devices, as well as test glasses and test pet cocks, are placed throughout the system.

On Fig. 8 the course of cooling water is indicated throughout by an arrow with an "o" midway up the shaft.

INDUSTRIAL RESULTS OBTAINED BY THE BREGEAT PROCESS

The Bregeat process was discovered and developed industrially in France during the war. At that time the inventor directed all his activity toward the war industries (manufacture of smokeless powder and application of airplane dope), which opened up a very large field for the process. In France alone the consumption of alcohol

for smokeless powder attained a figure of about 20,000 tons per month; the consumption of various solvents for airplane dopes (benzene, ethyl acetate, acetone, methyl alcohol, etc.) attained a figure of 550 tons per month in the middle of 1918.

The first industrial apparatus for the recovery of volatile solvents by means of the Bregeat system was started at the beginning of 1917 at the powder works of Sevran (near Paris). This apparatus, which was built at the expense of the inventor, was furnished only with very lean gaseous mixtures, taken from the atmosphere of the workrooms without any collecting devices whatsoever. In fact the concentration was about 5 g. of ether-alcohol per cubic meter of gaseous mixtures—a very low figure. At the same time at Sevran there was being tried out a process for the recovery of solvent by sulphuric acid (Barbet) and another process by compression-refrigeration (G. Claude).

The Bregeat process proved so successful that the French Government decided to equip all French powder works with it. Table I shows the dates of erection of the various Bregeat plants in France and in England during the war. It will be seen from the dates of putting into operation that little time was lost after the successful Sevran tests that demonstrated the worth of the process. In England sixteen sulphuric acid recovery units were discarded and replaced, or were in the course of being replaced at the time the armistice was signed, by the Bregeat process in various English explosives works.

Since the war contracts have been signed in France, Belgium, England and Germany with film works, coke works, artificial silk works, artificial leather works and explosives works for the recovery of solvents by the

TABLE I. VARIOUS FACTS ABOUT BREGEAT SOLVENT RECOVERY PLANTS IN ENGLAND AND FRANCE DURING THE WAR

Name and Location of Bregeat Plant	Kind of Solvent Recovered	Process From Which Solvents Were Evolved	Cone. (g. per cu.m.) of Solvent Vapor in Mixture	Date of Putting Into Operation	Actual Recovery Over Certain Periods
Sevran (France)—(Test apparatus)	Ether-alcohol	Manufacture "B" Powder	5	End of 1916	February, 1917—421 kilos
Sevran (France)	Ether-alcohol	Manufacture "B" Powder .....	.....	Oct. 12, 1917	Total to Nov. 15, 1918: Ether 303,-901 liters, alcohol 47,280 liters
Ripault Ancienne (France)	Ether-alcohol	Manufacture "B" Powder	8 to 10	Dec. 19, 1917	Total to Nov. 15, 1918: Ether 963,-750 liters, alcohol 230,034 liters
Ripault Nouvelle (France)	Ether-alcohol	Manufacture "B" Powder	8 to 10	Feb. 21, 1918	Total to Nov. 15, 1918: Ether 526,-106 liters, alcohol 110,357 liters
Toulouse Braqueville (France)	Ether-alcohol	Manufacture "B" Powder	8 to 10	July 6, 1918	Total to Nov. 15, 1918: Ether 275,-557 liters, alcohol 58,968 liters
Pont de Buis (France)	Ether-alcohol	Manufacture "B" Powder	8 to 10	Aug. 30, 1918	Total to Nov. 15, 1918: Ether 160,-012 liters, alcohol 19,754 liters
Toulouse Empalot (France)	Ether-alcohol	Manufacture "B" Powder	8 to 10	Oct. 22, 1918	Total to Nov. 15, 1918: Ether 39,-052 liters, alcohol 4,527 liters
St. Medard Ancienne (France)	Ether-alcohol	Manufacture "B" Powder .....	.....	Under construction at armistice .....	.....
St. Medard Nouvelle (France)	Ether-alcohol	Manufacture "B" Powder .....	.....	Under construction at armistice .....	.....
Bergerac (France)	Ether-alcohol	Manufacture "B" Powder .....	.....	Under construction at armistice .....	.....
Pyrotechnie Maritime de Toulon (France)	Acetone, Alcohol	Manufacture of Explosives, Lacquering of shells .....	.....	.....	.....
Voisin-Paris (France)—(Commercial plant)	Acetone, MeOH Methyl acetate	Doping of airplane wings	8.5	Completed Nov. 11, 1918 .....	.....
Gretton (Scotland)—(Government plant)	Ether-alcohol	Manufacture of cordite .....	.....	Dec., 1917	First month 1918: Ether 1,439,375 liters, alcohol 2,158,414 liters
Misk (England)—(Commercial plant)	Ether-alcohol	Manufacture of cordite .....	.....	1918	First month 1918: Ether 1,446,167 liters, alcohol 1,857,942 liters
Ardeer (England)—(Commercial plant)	Ether-alcohol	Manufacture of cordite .....	.....	1918	First month 1918: Ether 1,275,588 liters, alcohol 1,497,201 liters
Pembrey (England)—(Government plant)	Ether-alcohol	Manufacture of cordite .....	.....	1918	First month 1918: Ether 451,559 liters, alcohol 476,946 liters

Bregeat process. Several of these plants are now operating or in the course of being put into operation, among which the following may be mentioned: Pathé Frères, Vincennes (France), (film manufacture); Mines de Carmaux (France), (debenzolization of coke-oven gas); Michaut-Masson, Clichy (France); Jenatzy-Leleux, Brussels (Belgium), (both above manufacturers of coated fabrics); Obourg (Belgium), (manufacturers of artificial silk by the collodion process); Caulille (Belgium), (explosives); Leto-photo, Edgeware, Middlesex (England), (film).

The gaseous mixtures treated in these plants are often very lean—of a concentration of only about 8 to 15 per cent per cubic meter—and in some cases these gaseous mixtures are subject to large fluctuations in concentration of solvent vapor, frequently in very short periods of time.

OPERATION DATA ON THE BREGEAT PROCESS

The accompanying facts and figures (Table II) taken from an official report of the French Government on the operation of the Bregeat process at the explosives works of Ripault (near Tours, France) are given as an illustration of the operation of the Bregeat process in France.

The volume of gaseous mixtures treated was about 12,000 cu.m. per hour at average room temperature. The concentration of ether-alcohol vapors in the air averaged 8 to 10 g. per cubic meter; with regard to this it is to be noted that these gaseous mixtures were taken from the vicinity of the presses and mixing machines, the rich mixtures from the drying ovens being treated by a condensation process already installed. In normal and continuous operation about 90 per cent of the ether-alcohol vapors entering the Bregeat apparatus were re-

TABLE II. CONSUMPTION OF ELECTRICITY, STEAM, WATER AND ABSORBENT PER KILO OF ETHER-ALCOHOL RECOVERED AT RIPAUT (EXPLOSIVES WORKS), TOURS, FRANCE

Items	First Period Consumption	Second Period Consumption	Third Period Consumption	Fourth Period Consumption	Average Consumption
Labor, hr.	0.0116	0.0144	0.012	0.0196	0.144
Electricity, kw.-hr.	0.111	0.13	0.104	0.1694	0.1286
Steam, kilos.	4	7.34	4	4	4.835
Water, cu.m.	0.12	0.2	0.16	0.28	0.19
Absorbent, kilos.	0.085	0.113	0.092	0.149	0.11

covered separately in the liquid form as 65 deg. Bé. ether and 96 deg. Gay-Lussac alcohol, both immediately re-employable in the manufacture.

In Table II the consumption of steam, water, electricity, absorbent and the amount of labor required are set forth.

In 1917, when this Ripault plant was built, the first cost of installation for the recovery of approximately 2,500 kg. of ether-alcohol per twenty-four hours was about 150,000 f. Figuring the interest on this sum at 10 per cent and with an addition of 4 per cent per year for taxes, insurance and maintenance, the resultant average net operating cost per kilo of solvent recovered for Ripault was 0.337 f. per kilo.

The Ripault (Ancienne) apparatus, described above, was one of the earlier and smaller recovery installations. The Bregeat installations in many of the other explosives works in France and in England were much larger. At Gretna there was the largest solvent recovery system in the world, which, although not designed by the

Bregeat engineers, utilized the Bregeat absorbent. And even under the far from favorable conditions obtaining there, the Bregeat system was so satisfactory that the sulphuric acid process was replaced elsewhere in England.

SUMMARY

The history of solvent recovery is one of individual effort, unco-ordinated endeavor, and delusion. Until the Bregeat process had been developed solvent recovery was not an industry by itself. The Bregeat process is responsible for bringing solvent recovery out of the class of an incidental and casual art into that of an independent and well-established business. This is due to the fact that it is the first solvent recovery process to be general in its application.

No longer does the American manufacturer consider the resources of the country inexhaustible. Competition is growing increasingly severe. Conservation of existing materials, recovery or recuperation of materials previously wasted are acquiring rightfully an ever more important place in industry. In the United States, where many manufacturers utilize and to a large extent lose volatile solvents, the opportunity is obviously large for an industrially proved solvent recovery process, one which applies to all cases, such as the Bregeat process.

Pig Iron Production in France

France's production of pig iron before, during and since the end of the war, has been as follows:

	Tons
1913	5,207,197
1916	1,447,000
1917	1,684,000
1918	1,297,000
1920	3,317,371

Of this 3,289,318 tons was made with coke and 28,053 tons in electrical furnaces.

The distribution of this production according to the various types of pig iron before the war and at present is as follows:

	1920 Tons	1913 Tons
Cast iron	797,939	953,683
Refined pig iron	275,153	532,003
Bessemer pig iron	76,289	124,336
Basic pig iron	2,050,129	3,508,837
Special cast iron	117,861	88,328

According to the estimates of industrial engineers, when France has completed the work of reconstruction and is again able to turn to the normal development of her industries, she will be able to produce 11,000,000 tons of pig iron per annum, or 282 kilos per capita, as compared with 132 kilos in 1913.

In 1913 France consumed 5,144,000 tons of pig iron. In 1920 she consumed 2,993,371 tons.

France's exports and imports of pig iron in 1913 and 1920 were as follows:

	1913 Tons	1920 Tons
Exports	148,000	306,000
Imports	70,000	132,000

Alsation Potash Production During 1920

The total production of Alsation potash during 1920 reached 1,061,197 tons, according to statistics received from the office of the commercial attaché, Paris. Of this amount 450,000 tons was sold in France, 327,000 tons was exported to the United States, 117,000 tons to Belgium, and 92,000 tons to the United Kingdom.

Ductile Electrolytic Nickel*

An Outline of the Experimental Work on the Electrolytes, Cathodes and Anodes Leading to the Production of Electrolytic Nickel of Greatly Improved Mechanical Properties

BY CHARLES P. MADSEN†

THE general failure to produce alloys for electrical heating purposes by metallurgical means which would come outside of the patent situation developed in 1916² led to the conception that a better type of resistance alloys and armors for heating units could be made by electrodeposition. It was believed that nickel or cobalt would be the best major ingredient and it was taken for granted that disclosed processes for making heavy deposits of these metals produced the results claimed. A few trials, however, soon showed this belief concerning nickel to be an error. In some cases claimed results of the inventor could not be reproduced, while in others a heavy deposit could be obtained only once in the same electrolyte, and in all cases the metal produced was mechanically very imperfect and became even more brittle after heating.

Attention was then turned to cobalt, and better results were obtained but not perfect enough to warrant the added cost. A more thorough review of the nickel art was then made and research instituted for determining the factors governing the production of heavy and mechanically perfect deposits of nickel.

All known baths were tried and particularly was Dr. O. P. Watts' review³ followed carefully. The work has occupied a period of over five years, during which time several thousand deposits of $\frac{1}{8}$ in. (0.8 mm.) thick and over have been made. It has, however, been carried out largely by empirical methods, and sufficient data have not yet been obtained for formulating the physical factors on a scientific basis. However, practical results have been produced, which appear worth while recording at this time.

This paper is therefore intended only as a report of the general work done and how the result was obtained, and it is hoped that the physical data can be standardized at an early date and be made the subject matter of a subsequent paper.

ELECTROLYTES

The early work was concentrated upon the electrolyte, and the results were so erratic and inconstant that the following general conclusions were drawn:

First. The usefulness of any nickel electrolyte can be determined only after its entire metal content has been replaced from the anode.

Second. No conclusion can be drawn from deposits less than 0.01 in. (0.25 mm.) thick.

Third. Reports of results with any electrolyte are of no value, without knowing the exact analysis of the anode used.

It was found that no electrolyte would entirely fulfill the first condition with any type of commercial anode, and the results were therefore variable. The so-called 97-98 per cent cast anodes containing manganese were found to deteriorate the bath most rapidly, while anodes of the same nickel percentage containing tin performed little better and introduced the difficulty of forming metastannic acid under certain conditions. On the other hand, it was found that while the so-called 92-96 per cent cast anodes containing iron maintained the bath nearly constant, although their efficiency was rarely 100 per cent on their nickel content, the large amount of ferric hydrate caused considerable difficulty in making heavy deposits. It was also found that the ratio of the anode to cathode surface was more important than usually supposed and was apparently a function of the anode composition. It was in all cases necessary to have from two to five times greater anode surface than that of cathode, and in some cases from ten to fifteen times.

ANODES

Attention was then turned to the use of relatively pure nickel metal as anodes. Some investigators state that pure nickel is passive, while others claim good results with its use as anodes. Imported pure nickel made by Fleitman⁴ and Pfanstiehl were tried, also hot-rolled nickel and electrolytic nickel made by the International Nickel Co., as well as domestic so-called cold-rolled malleable nickel. In these cases it was found necessary to have some chloride present, but a limit was found beyond which any further chloride addition did not improve the result in each case. The imported pure nickels performed fairly well for a time, but became passive in a variable and most exasperating manner without apparent cause. The hot-rolled material was always more passive in the same electrolyte than either of the imported pure nickels or any of the cast anodes, and also varied in its performance. Hammond⁵ and Mathers⁶ report the successful use of International electro-nickel as anodes, particularly after annealing, but the annealing methods are not described. It was found that such material unannealed was even more passive than either the imported pure nickel or hot-rolled; annealing always improved their action, but different methods produced different results. Electro-nickel annealed in an atmosphere of CO dissolved with an efficiency of about 95 per cent and did not turn passive as readily as either pure material, but sufficiently so as to cause pitting. Its use for heavy work was, however, furthermore rendered impractical,

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²Marsh patent, No. 811,859.

³Transactions, Am. Electrochem. Soc. (1913), vol. 23, p. 99.

⁴Vereinigte Deutsche Nickel Werke. *Chem. News*, 1879, vol. 40, p. 67.

⁵Transactions, Amer. Electrochem. Soc. (1916), vol. 30, p. 103.

⁶Transactions, Amer. Electrochem. Soc. (1916), vol. 29, p. 383.

because of the fact that the anodes dissolved irregularly, producing a sort of lace structure which readily crumbled, causing thereby a loss of from $\frac{1}{2}$ to $\frac{1}{3}$ of the anode and making the cathode deposit very rough unless the anodes were held in bags. The domestic so-called cold-rolled malleable nickel performed the best of any nickel tried, particularly with the proper amount of chloride present in the bath. It dissolved with an efficiency of about 97 per cent when free from passive portions. This type of anode was therefore used exclusively in the subsequent three years of this investigation. The average analysis of this material is as follows:

Ni	95.30
Fe	2.13
Cu	0.25
Mn	0.33
C	0.30
Si	0.23

Dr. Langbein⁶ and others report the use of rolled anodes extensively in Europe, and state that their alkaline and acid-forming characteristic is the reverse of that of cast anodes. It is not clear why this should be so, and the statement has been questioned. It was, however, carefully checked and found to be correct, and furthermore the ratio at which a neutrality balance is maintained was found to be very exact. It was found that when the anode is 1.77 times the area of the cathode, the bath will remain relatively neutral for long periods of time. Any increase of anode surface over this turns the bath acid and any decrease turns it alkaline, provided, however, the anode is free from passive portions. Unfortunately, however, such portions were often present, in which case the bath would always turn acid. Sodium sulphonate alizarin was used as an indicator for this purpose. Using these anodes, the general conclusions on electrolytes were as follows:

ADDITION AGENTS IN THE ELECTROLYTE

Nickel-ammonium sulphate is never an advantage over nickel sulphate as a metal carrier. A little alkali metal salt, however, should be present. The addition of conductive salt, as magnesium sulphate, etc., permits of a higher current rate, but the baths are not stable and reliable. The addition of citrates and other organic compounds diminishes the amount of sludge and favors the production of smooth and bright metal, but such baths are exceedingly unstable and the metal produced is always more brittle and cannot be carried to the same thickness as in the same electrolyte without the addition agent.

It has been reported by others that while a nickel electrolyte should be nearly neutral some free hydrogen ions are necessary. This was found to be correct and that boric acid is the best carrier of such hydrogen ions. It is necessary to have some chloride present, but a bath consisting of nickel chloride only would not produce perfect metal even when containing boric acid. It was found that nickel chloride was best and Dr. Watts⁷ bath was finally adopted as standard for most tests. This bath has, however, recently been modified and addition agents introduced.

Warming the electrolyte is an advantage in all cases, but usually little improvement was obtained above 55 deg. C.

With this modified bath, using the cold-rolled nickel

anodes described, many deposits upward of $\frac{1}{16}$ in. (1.6 mm.) could be made in succession, but they were not fully malleable, nor would they stand heating without becoming more brittle, and they often contained pits and other mechanical imperfections.

ELIMINATION OF BRITTLENESS

Other investigators have shown that the embrittlement of electrolytic nickel and perhaps pits are caused by hydrogen. Various means were tried for eliminating hydrogen. It was found that agitating either mechanically or by air resulted in no benefit, but often instead resulted in a much rougher deposit. Various manipulations of the cathode, as shaking and striking, were tried, but without benefit, and it was observed that the hydrogen bubbles would immediately return after removal. Brushing the cathode mechanically was tried, and it was found that while the deposits thus produced possessed a mirror-like smoothness, they were even harder and more brittle than those produced without brushing.

Since one object of this work was the production of armors for electrical heating units, the deposits were made on objects which were supposed to simulate the character of surface which such a heating unit would possess for coating. These objects were glass tubes about $\frac{1}{2}$ in. (9.5 mm.) in diameter and 3 in. (7.5 cm.) long. They were prepared for deposition by the well-known silver-fire process. Several hundreds of these were made and one reason for adhering to their use was the observation that in addition to determining the limits of the thickness by the deposit bursting open, it would often happen that a deposit would build up thick and develop sufficient strain to crush the glass. In this way data could be obtained on those deposits which did not peel or crack open.

The use of these glass tubes as cathodes, however, led to a discovery in a peculiar way. If the deposit cracked open it would nearly always do so along the bottom, and would often occur a considerable time before being observed. In the anxiety to save time and to detect the crack as soon as formed, the cathodes were often jerked out of the bath quickly in order to inspect the bottom of the tube for cracks and then reimmersed. Since it is taught in the art that interruption of current or removal of the cathode will result in laminated deposits, a careful record of these removals was kept and when a large number of cathodes were studied the surprising fact was disclosed that all those which had been subjected to this removal for observation were both much thicker and much more malleable than others, almost regardless of other conditions. A cathode was then made which was removed and re-inserted quickly every few minutes for twenty-four hours. This was found to be by far the most perfect deposit produced.

TIME FACTORS FOR THE PERIODS OF EXPOSURE AND OF DEPOSITION

The time factors were then determined for both the period of exposure and the period of deposition. It was found that, contrary to former beliefs, the cathode removal, if not over fifteen seconds in duration, produced no laminated deposits, but instead, homogeneous and highly ductile deposits. It was also found that the frequency of removal necessary for producing the best results depended upon the factors of deposition influencing the formation of hydrogen, such as anode efficiency, temperature, acidity and current density.

⁶"Electrodeposition of Metals," 7th Ed., p. 273.

⁷Transactions, Amer. Electrochem. Soc. (1916), vol. 29, p. 395.

With the improved bath mentioned above, operating at 55 deg. C., with a current density of 72 amp. per sq.ft. (8 amp. per sq.dm.), it was found that with 97 per cent commercial cast anodes, this necessary frequency of removal or deposition period was thirty seconds to one minute, while with the cold-rolled anodes it was about one to five minutes. An automatic device was then constructed for carrying out this operation, and all of the sample deposits made at the Bureau of Standards and which were exhibited at our last Atlantic City meeting were made by this means.

PHYSICAL PROPERTIES

A physical study of the metal so produced showed that it possessed a far higher degree of ductility than was expected, even exceeding that of any nickel heretofore produced. It was found to have a slightly lower electrical resistivity but a slightly higher density. It was, furthermore, found that the deposited metal could be heated red-hot either before or after rolling without embrittling it. Wires have been drawn from a bar $\frac{1}{8}$ in. (3 mm.) in diameter down to 0.002 in. (0.05 mm.) without annealing. This new nickel, however, develops considerable hardness and increase in tensile strength upon rolling or drawing. The tensile strength of the deposited metal is about 72,000 lb. per sq.m. (50 kg. per sq.mm.), while the wire mentioned above showed a strength of 250,000 lb. per sq.in. (175 kg. per sq.mm.). The Brinell test of the deposited metal is about 130, while that of metal which has been rolled from a plate $\frac{1}{8}$ in. (3 mm.) thick to $\frac{1}{32}$ in. (0.75 mm.) is about 150 Brinell, and it is still malleable. Tests with the Ericsson machine showed a drawing ability better than that of ordinary hard-rolled brass or copper and about equal to dead soft copper.

The average analysis of this new electrolytic nickel is:

Ni	99.70
Fe	0.01
Cu	nil
C	0.02

CAUSES OF PITS

A contemplation of the general utility of a metal of such remarkable properties in the face of certain war demands caused relegation into the background of the original object of producing electric heating or resistance units, and we concentrated instead upon the development of production of sheet metal and of various intricate forms as dies, molds, etc., for industrial purposes. It was soon found, however, that while the metal produced by the means outlined above was highly ductile, it was not always mechanically perfect. The principal trouble was pits of various types, which would appear and disappear in the most exasperating and unaccountable manner. Much has been written concerning the nature and cause of pits in nickel plating, but without any permanent remedy having been found. The last two years of this work were therefore devoted, more or less, to an investigation into the cause and remedy of pits. Many old means were tried for their elimination but without good results.

It was found that small solid particles would cause imperfections, but that the type of pits most troublesome was not so caused. It was also found that excess of air in the electrolyte, which has been shown to be a cause of producing pits in the electrodeposition of lead⁸ was not a primary cause, although its presence might

exaggerate the pits if the primary cause were present. The influence of the exact degree of neutrality with relation to solvent acid hydrogen ions was also studied, and it was found that while more hydrogen was generated and a less malleable metal made in an acid bath, this condition is not the primary cause of pits, but will only exaggerate them, if the primary cause is present. The primary cause of pits was finally traced to inherent characteristics of the anode.

PRODUCTION OF PITLESS METAL

The metallurgy and refining of nickel was then studied and several hundred different kinds of anode castings were made. A new anode composition was finally found which, when used with the hydrogen elimination process, produces pitless metal continuously and without diminishing the metal concentration of the bath. It was furthermore found that for reasons which are not altogether clear this anode causes the generation of so small an amount of hydrogen that the necessary frequency of cathode removal is decreased from every five minutes to every two hours.

Many castings have been made which require a removal only every ten or fifteen minutes and will make pitless metal up to $\frac{1}{2}$ in. (0.75 mm.) thick, while a few casts have been made which require removal only every two hours and pitless cathodes have been made with these up to $\frac{1}{8}$ in. (3 mm.) thick. Indications are that the perfection of these anodes will enable the production of pitless metal of any thickness even without the hydrogen elimination process.

It is thought best to defer the disclosure of this anode until it is fully developed and standardized on a commercial basis.

Killing Molds on Lumber by Steaming*

Molds thrive on the surface of wood when it is moist and warm. In a dry kiln molds often develop on the surface of the lumber to such an extent that they seriously obstruct the circulation of air through the pile. This is such a decided hindrance to successful kiln drying that steps must be taken to prevent the mold growth. Various experiments have been made to find a means of accomplishing this result without injury to the lumber.

The safest method found of stopping the growth of mold on lumber in a kiln is to steam the stock at 170 or 180 deg. for a period not exceeding an hour. This treatment heats the surface of the stock sufficiently to kill the mold, and at the same time the saturated air prevents too rapid surface drying, so that the injurious effects which otherwise would be produced on the wood by such high temperatures are avoided.

Unless it is desired to relieve drying stresses at the same time, the interior of the stock should be heated as little as possible. Therefore, the steam supply should be sufficient to reach the desired temperature in twenty-five or thirty minutes. To accomplish this result, plenty of live steam at a pressure of at least 70 lb. gage must be available. The size of supply line and the number and size of perforations that may be required in the steam jet line will vary with local conditions; it is impossible to make them too large or too numerous, as the quicker the steam is supplied the better the effect.

Care should be taken to see that the stock cools in nearly saturated air. Otherwise the surface will dry too rapidly, and casehardening difficulties will set in.

^{*}Transactions, Amer. Electrochem. Soc. (1919), vol. 35, p. 279.

*Forest Products Laboratory Technical Notes.

The Control of Chlorine in the Bleaching of Cotton Goods

By C. M. EDWARD SCHROEDER*

SINCE liquid chlorine became available on the American market in convenient form for handling, the preparation of bleaching liquors of superior quality and uniform composition at once established an improvement which rapidly superseded the more cumbersome and uncertain production of bleach liquors from chloride of lime or bleaching powder. Prior to the introduction of liquid chlorine there had been no material change in the process of cotton bleaching for many years, but the preparation of sodium hypochlorite bleaching liquor, or chemic, with chlorine constituted an improvement of great practical value.

The immediate advantages, aside from cleanliness and ease of handling, derived from using chlorine-soda chemic over the old chloride of lime or bleaching powder solutions are twofold: 1. Chlorine-soda chemic can be made up under constant control of bleaching strength, in clear liquors, ready for immediate use. (Chloride of lime losing strength on exposure and depositing sludge in making up.) 2. There being no lime salts present as in the chloride of lime chemic, goods will not be in danger of tendering or discoloration, and for the same reason goods for dyeing will not show unevenness from lime residues.

During the writer's experience of about ten years past in the handling of liquid chlorine for bleaching purposes, certain improvements and economies have been developed in the matter of control which make this seem a subject worthy of description.

EARLY BATCH MIXING PRACTICE USING CHLORINE

In the earlier experience with preparation of chlorine bleach no attempt was made to control the gas supply by means of special apparatus, but as the gas was obtainable in steel cylinders, holding approximately 100 lb. of chlorine (the filled cylinder weighing about 200 lb.), it was simply necessary to place the cylinder of chlorine on a platform scale and note the amount of gas used up in the preparation of stock chemic.

For further convenience in the daily preparation of large quantities of bleaching liquors, weighing the

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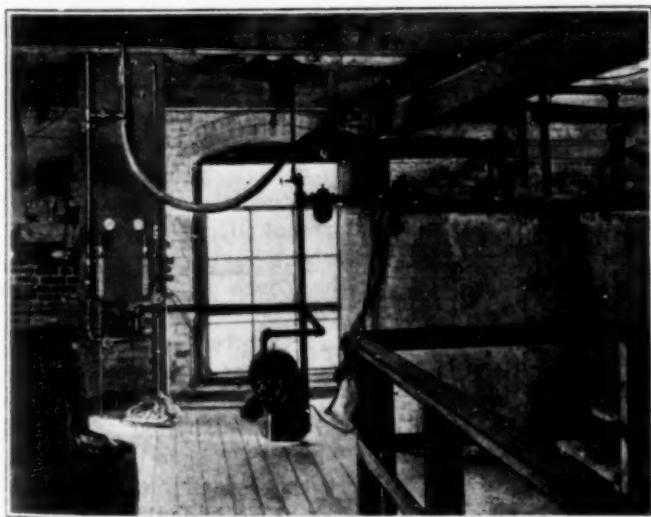


FIG. 1. VIEW OF INSTALLATION

chlorine was dispensed with, as it was necessary only to discharge one full cylinder into each tank of soda liquor holding about 800 gal., the cylinders being connected to a $\frac{1}{2}$ -in. lead pipe leading to the bottom of tanks holding the liquor, and the chlorine allowed to enter at full capacity. Of course means had to be employed to overcome reduction of the gas flow due to lowering of temperature caused by such rapid evaporation.

Formerly this was accomplished by placing the cylinders in tubs supplied with warm water, but later the liquid chlorine was allowed to flow from the cylinders placed in a horizontal position, and was conducted through a coiled section of the lead pipe submerged in a tub of warm water, the expanded gas escaping from the end of a lead pipe at bottom of chemic tank. By this means 100-lb. cylinders could be emptied in from one to one and one-half hours.

EXCESS OF ALKALI REQUIRED

It may be observed here that bleach liquors prepared as above described necessarily contain an excess of alkali to insure stability, which in the case of soda ash is not of much consequence excepting as regards cost, but in using an excess of caustic soda there is always danger of deleterious action on the cotton fiber, especially in warm weather, when oxy cellulose is likely to form while the material is undergoing the bleaching operation and may cause subsequent tendering and yellowing of the fabrics.

Before the introduction of proper control equipment the procedure was as follows: At first soda ash alone was used to absorb the chlorine, in the proportion of about 3 to 1—that is, taking 300 lb. of soda ash in 800 gal. of water to each 100 lb. of liquid chlorine, yielding a stock chemic with approximately 1.5 per cent available chlorine. This when run in the bleaching machines at 1 to $1\frac{1}{2}$ deg. Tw. furnished a safe and active bleach, although the actual cost of such a bleach was somewhat higher than bleach made of chloride of lime. This cost was later reduced when the chemic tanks were charged with waste caustic soda recovered from mercerizing washings running from 4 to 6 deg. Tw. and enough soda ash added to bring the Twaddell up to about 10 deg.

The excess of soda ash was required to insure stability during the rapid absorption of the gas and while storing the chemic. The bleaching strength was determined on each batch made by titration with N/10 arsenious acid.

PREPARATION OF NEUTRAL CHEMIC

With the installation of Wallace & Tiernan chlorine control equipment the possibility of preparing neutral chemic from caustic soda solutions at once removed the foregoing objections.

There being no need of using an excess of alkali with this method, the cost of soda ash formerly required was entirely eliminated, the waste caustic from mercerizing washings furnishing the necessary supply of alkali. On account of the perfect control of pressure and rate of flow of chlorine, it is possible to utilize caustic liquors of any convenient strength and obtain a sodium hypochlorite of any desired composition and uniformity. That is, by adjusting the chlorine feed valve to supply just enough chlorine to combine with the sodium hydroxide in the caustic liquors, there is

formed a neutral hypochlorite solution in accordance with the reaction:



and such a bleach liquor is at once ready for use from the moment of starting and as long as the machine is kept running.

FLEXIBILITY OF OPERATION

A valuable feature of this apparatus is its flexibility in operation. For instance, if a bleach liquor is required for storing any length of time a slightly alkaline liquor can be prepared by simply reducing the proportion of chlorine to the caustic content of the absorbing liquor.

Or, if an acid bleach is required, an excess of chlorine is fed in giving a hypochlorite solution according to the following reaction:



thus furnishing a safe means of producing the more rapid hypochlorous acid bleach without the danger of liberating free chlorine as was apt to occur by the old practice of adding acids to bleaching liquors, with attending deleterious effect on the goods.

DESCRIPTION OF BLEACHERY INSTALLATION

A Wallace & Tiernan control equipment which has been under the writer's observation since August, 1920, at the plant of the Standard Bleachery Co.,

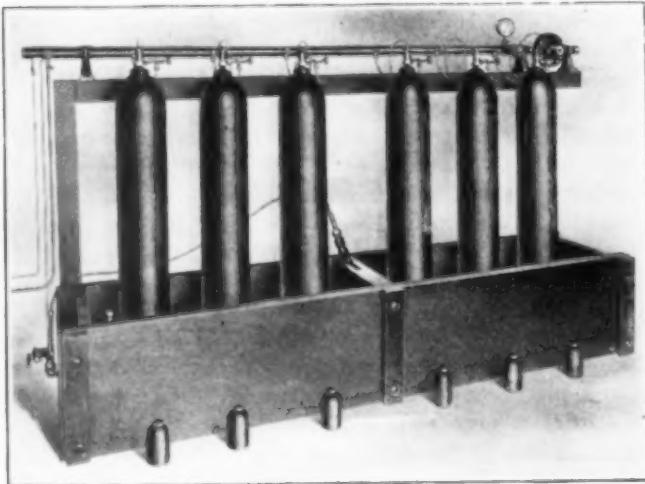


FIG. 2. LIQUID CHLORINE EVAPORATORS

Carlton Hill, N. J., was installed to produce 500 gal. of bleach per hour using only waste caustic liquors of about 4 deg. Tw. for absorbing the chlorine and furnishing a steady supply of chemic with from 1.25 to 1.5 per cent available chlorine.

The apparatus consists of a panel upon which is mounted a specially designed injector which effects the combination of the chlorine with the caustic solution. This combination is practically instantaneous, the chemic of full strength and ready for use passing immediately to the stock tank. Indicating meters of the Venturi type are placed in both the chlorine and caustic lines on the panel. The chlorine gas is supplied at the desired rate and under constant pressure from an evaporator that is essentially a steam-heated water bath equipped with thermostat control and pressure-regulating valve.

The control panel was placed in the same room in which were housed three cylindrical brick tanks of about 800-gal. capacity used for making up and stor-

ing chemic, and without changing the existing layout it was possible with this outfit to furnish a supply of bleach equal to the demand formerly met by the three mixing tanks. The accompanying photograph shows how the apparatus was placed. The brick tank shown to the right is the first of the three chemic tanks above referred to, which was put to use as a reservoir for the waste caustic liquor to be fed to the apparatus by means of the centrifugal pump on the floor.

The bleach liquor is discharged into the large rubber hose falling in a loop from the top of the control panel and conducted to either of the other two tanks, from the bottom of which the chemic is drawn to the bleaching machines. One of these tanks is generally kept partly filled to hold in reserve enough stock chemic to meet any fluctuation in draft.

The evaporator outfit, holding four 100-lb. chlorine cylinders, was placed on the ground level directly below the control apparatus.

The only difference in handling the gas supply by this method as compared with the former in use is that four or more cylinders are connected up at once to a manifold allowing the gas to flow through the meter at a maximum rate of 60 lb. per hour for each 500 gal. of caustic liquor, while by the former method the same number of cylinders are connected up separately for each 800-gal. batch made up. That is, by the old method 300 lb. of chlorine would be consumed in making up three tanks, or 2,400 gal. of chemic in one day, while with the Wallace & Tiernan control equipment 3,000 gal. of chemic can be made up in six hours with a maximum consumption of 360 lb. of chlorine.

SAVINGS BY USE OF THE APPARATUS

The saving in cost of soda ash in one week's run with the control equipment as compared with a week during which the same yardage of goods was run by the older method amounted to \$33.

A comparison of six weeks' steady running of the control equipment with a similar period using part soda ash for chlorine absorption showed a total saving of \$219, or \$36.50 per week.

Production of Camphor in Taiwan

The production of camphor during the year ending March 31, 1921, it is anticipated, will exceed that of the preceding year by 275,000 lb., the amount being placed at 6,000,000 lb. Though exports have stopped for the present, the stock of crude camphor on hand does not exceed 750,000 lb., as it is being turned over to Japanese refiners as soon as it is cleaned and pressed at the plant in Taihoku. The monopoly bureau is gradually increasing its rate of production in anticipation of a revival of the celluloid industry in the late summer or early fall of this year, when present stocks of celluloid will have been depleted, the output having been accelerated from 480,000 lb. during the month of July, 1920, to the present monthly rate of 600,000 lb. It is too early to estimate the total output for the twelve months beginning April 1, 1921, as the survey of the camphor forests has not yet been reported upon. No orders from or allotments to the United States, Great Britain or France for the first quarter of 1921 have been reported. The price of camphor for the second quarter has not been announced, but as prices of commodities in general are declining it is supposed that camphor will also be affected.—*Commerce Reports*.

Molybdenum Steel and Its Application*

Beneficial Effect of a Little Molybdenum on the Physical Properties of Complex Alloys, Especially Allowing Safe Use of High Working Temperatures and a Wide Range of Quenching and Annealing Heats

BY M. H. SCHMID

Metallurgical Engineer, United Alloy Steel Corporation

WHILE it is true that molybdenum structural steels were commercially developed during the World War, and through their development great advancement in army and navy equipment and accessories were rendered possible, it is equally true that war conditions merely furnished the impetus for this development. The commercial application of molybdenum steels for industrial purposes was inevitable, the assurance of adequate and accessible domestic supply of this important alloying element allaying all fears as to the ability to meet future commercial demands.

That the earliest experiments in molybdenum steels were confined largely to tool and magnet steels is not surprising in view of the fact that molybdenum was not then known to exist in sufficient quantities to warrant its consideration (other than purely academic interest) for commercial structural requirements. It is surprising, however, to note that in spite of the then limited available supply of this alloying element the earlier experimentation on structural steels was in most cases confined to material of a much higher molybdenum content than is considered advisable at the present time. It is also surprising that practically all study was confined to its direct effect in the ternary steels instead of more research on its indirect effect or additive and intensifying effect on other elements in the quaternary and more complex alloy steels. It is of course quite possible that research along the latter lines was pursued but not published. It is a fact, however, that exhaustive research directed by C. H. Wills established the practicability of the commercial application of molybdenum as an alloying element in the various types of alloy steels.

BENEFICIAL EFFECT OF MOYBDENUM

A review of the many types of steel on which the addition of molybdenum has a distinctly pronounced beneficial effect enables us to grasp the diversity of the application of molybdenum steels. Its effect is pronounced in straight carbon steels, chromium steels, nickel steels, chromium-nickel steels and vanadium steels. In straight carbon or nickel steels, by uniting with the ferrite additional strength is imparted without corresponding decrease in toughness. In steels containing chromium, probably through the formation of double carbides, additional strength and hardness is imparted together with beneficial effect due to any diffusion in the ferrite. The penetrative effect of heat-treatment, especially in large sections, is decidedly pronounced.

I think most of us can recall the time when the selection of alloy steels for various products was based

almost entirely on the physical characteristics obtainable. There are now a variety of types of alloy steels in which there is very little difference in physical properties, all of which will yield the necessary strength and factors of safety in the finished product. The present consumer of alloy steels, having at his command many types that are satisfactory so far as static and dynamic qualities are concerned, is influenced in his choice of material by the efficiency of the product in proper and economical functioning in the various manufacturing processes. From the manufacturing standpoint he wants a steel which first of all has a tendency toward the minimum of inherent defects; he wants a steel which gives the most efficient response to the various thermal and mechanical manipulations to which it is subjected in the numerous stages of processing from the raw material to the finished product.

REQUIREMENTS OF ALLOY STEEL

Careful consideration of the following requirements should be given by the customer in his selection of an alloy steel:

- (1) It shall meet such specifications as are imposed by the engineering department.
- (2) The elements used in its manufacture shall be readily obtainable with assurance of adequate source of supply for the future.
- (3) It shall not be subject to patent litigation.
- (4) It must be entirely practicable as a commercially manufactured product of uniform quality.
- (5) It must respond satisfactorily to various thermal manipulations with reasonably wide temperature ranges.
- (6) It must respond satisfactorily to various mechanical manipulations.

We will now review these requirements in detail from the standpoint of molybdenum steels.

SPECIFICATIONS

There is little need for a detailed discussion regarding physical characteristics. "Molybdenum Commercial Steels," published by the Climax Molybdenum Co., gives concise information as to just what physical properties may be developed on the various types of molybdenum steel. We know that the chromium-nickel-molybdenum steels used on Liberty motors for aircraft service met the most exacting specifications, and records of tests on physical properties showed results superior to those obtained on any other types of steel used in this class of work. As far as the desired physical properties are concerned, it appears but necessary to select the particular type best suited for the purpose under consideration. For general requirements for automotive or machine construction, the chromium-molybdenum steels are usually recommended. For special requirements it

*Paper presented April 22, 1921, before the Washington Chapter of the American Society for Steel Treating.

becomes necessary to use the more complex types, such as chromium-nickel-molybdenum.

RAW MATERIAL

The supply (present and future) of ferromolybdenum for commercial production has been assured. Sufficient ore deposits adequate for many years' production have been established, with the necessary mining and refining capacity to take care of all future requirements. Four-fifths of the world's known available supply of molybdenum is contained within the borders of the United States. The present supply of chromium, the alloy most commonly used in connection with molybdenum, is practically inexhaustible and is found in most every part of the world.

PATENTS

The recent action whereby any alloy steel manufacturer in the United States may be licensed to produce chromium-molybdenum steels under patents during the life of same on a royalty basis which is so trivial as to have no bearing on the price of the steel should relieve any fear as to litigation.

MANUFACTURE

That the manufacture of molybdenum steels is on a practical commercial basis has been well established. The first heat of electric-furnace steel made by the United Alloy Steel Corporation was tapped Dec. 3, 1917, since which time this company has made in excess of 10,000 tons ingots of various types, comprising carbon-molybdenum, chromium-molybdenum, chromium-nickel-molybdenum, etc. The first open-hearth heat of molybdenum steel was tapped by this company May 24, 1918, and since that time approximately 25,000 tons has been produced.

No serious difficulties are experienced in the various stages of processing from melting and casting on through the rolling and cold-drawing operation. The manufacture of molybdenum steel merely requires the same care as is exercised in the production of any well-made type of alloy steel of similar potential properties—in fact, less care than is necessary on many types.

Molybdenum is available as a furnace addition in two forms, as ferromolybdenum and as calcium molybdate. In the ferro form it is most conveniently obtained and used with a molybdenum content of 50 to 60 per cent, although our company has very successfully used 70 to 80 per cent ferromolybdenum. In the form of calcium molybdate we have a lower percentage of metal, averaging 35 per cent. The ferro-alloy may be added in the open-hearth process as follows:

- (1) All additions in the furnace as the charge is melting down.
- (2) All additions in the furnace just prior to tapping (10 to 15 minutes).
- (3) All additions in ladle.
- (4) Part addition in the furnace and part in the ladle.

In the manufacture of molybdenum steels at our plant we have thoroughly investigated all of the above methods and have adopted the first as standard practice because of the better diffusion and higher degree of uniformity in the finished product, together with higher efficiency or minimized loss of the alloy.

It has been our experience that calcium molybdate is most satisfactorily added in sacks as the scrap charge is melting down, being so placed as to permit the partly molten scrap to cover or envelop the salt.

Greater care is necessary with calcium molybdate than with the alloy in ferro form in order to prevent the draft of the furnace from pulling off part of the powdered molybdate addition and carrying it to the furnace walls, ports and checker chambers. The average loss of metal added in ferro form by the first method outlined above should not exceed 5 to 10 per cent, the loss tending toward the minimum where the same furnace or furnaces are used on successive heats, thereby reducing the purely mechanical loss. Just how this loss may be subdivided is worthy of some discussion. A slight mechanical loss is inevitable and we may assume it as running between 2 and 4 per cent, leaving an additional loss of, say, from 3 to 8 per cent unaccounted for. I am not prepared to state just how this should be distributed. It is probably due to both oxidation and volatilization. Molybdenum additions in the ladle are generally inadvisable and where a high molybdenum content in steel is required should be made only in the molten condition.

Of worthy consideration is the utilization of molybdenum steel scrap, which may be included in the furnace charge with a yield of approximately the same ratio as direct alloying additions.

No special comment is necessary regarding ferromolybdenum and calcium molybdate charges in the electric furnace, where slagging, oxidizing and temperature conditions are under absolute control. Practically 100 per cent alloy efficiency is possible.

The blooming and finish rolling operations on molybdenum steel require no special precautions other than those necessary on corresponding types of other alloy steels, and the practice, measured in per cent of available finished product, is higher than in most types of similar properties. The tendency toward a minimum amount of inherent defects, both surface and subsurface, is very pronounced, especially as compared with nickel and chromium-nickel steels.

While molybdenum evidently has no deoxidizing or scavenging effect, it has at the same time no deleterious effects on the working of the steel, and a chromium-molybdenum steel should process as efficiently as the same type without molybdenum, and a chromium-nickel-molybdenum should process as efficiently as that type without this additional alloy. Molybdenum steels as a class may be considered more free from seams than nickel and chromium-nickel steels of corresponding potential values. It would be absurd, however, to claim that such defects in billets heal up or roll out in the finishing mill.

Wide temperature ranges are available for rolling and forging, and while there is no appreciable difference in the amount of scalage, there is a marked advantage in the texture of the scale over that on nickel steels. The scale is a loose, non-tenacious one, freely flaking from the steel, showing no tendency to roll into the surface and result in pitting.

THERMAL MANIPULATIONS

Molybdenum steels as a class may be subjected to unusually wide temperature ranges for both hot-working and heat-treating. This applies particularly with respect to the more generally used chromium-molybdenum types, which will satisfactorily withstand considerably higher temperatures than the corresponding types of nickel and chromium-nickel steels. Forging companies report that chromium-molybdenum steels flow better in the dies than other types, which advantage is probably

due to a large extent to the use of higher working temperatures. I cannot conscientiously credit molybdenum steels with less scalage loss, but it is certainly true that less difficulty is encountered in forging operations on account of the ease with which scale loosens from the bars in carbon-molybdenum and chromium-molybdenum types. Cleaner forgings are obtained and tumbling and pickling charges are minimized.

The outstanding features relative to the heat-treatment of molybdenum steels are the extremely wide quenching ranges available for practical heat-treatment, the excellent penetrative effect of such treatment on large sizes, and the broad drawing range causing but slight modification in physical properties, this due to the retarded disassociation and reversion to normal state upon heat application after quenching. Data have been published by the Crucible Steel Co., the Carbon Steel Co. and the United Alloy Steel Corporation showing uniformity in static properties through a wide range of quenching temperatures, but without information as to comparisons on dynamic properties.

To show that impact as well as static properties evidence no marked variation with quenching temperatures ranging from 1,500 to 2,000 deg. F. inclusive, I have taken average results from a series of recent experiments in our laboratories on chromium-molybdenum steel analyzing as follows: Carbon 0.27, manganese 0.66, sulphur 0.036, phosphorus 0.018, silicon 0.08, chromium 0.83, molybdenum 0.42. The size treated was 1 in. round and all tests were drawn at 1,050 deg. F., after quenching in water at the temperatures indicated.

Quenching Temperature	Elastic Limit	Tensile Strength	Elongation	Reduction		
				of Area	Brinell	Izod
1500	140,000	163,500	18.5	62.7	319	58
1600	139,500	161,700	17.0	63.1	321	62
1700	138,400	160,400	17.5	61.7	321	60
1800	138,300	158,500	18.0	61.5	319	61
1900	139,600	159,600	16.8	57.9	317	56
2000	140,000	157,000	17.0	59.0	317	55

Striking evidence of the penetrative effect of treating as well as the high drawing temperature available for attainment of high physical properties is manifested in our type "LM," chromium-nickel-molybdenum steel, used for crankshafts and connecting rods in aircraft work. The analysis range of this type is carbon 0.22 to 0.30, manganese 0.50 to 0.70, sulphur 0.035 max., phosphorus 0.030 max., silicon 0.10 to 0.20, chromium 0.70 to 0.90, nickel 2.75 to 3.25, molybdenum 0.30 to 0.50. Heats running 0.25 to 0.30 carbon were selected for crankshafts, and those running 0.22 to 0.25 were used for connecting rods. Physical results taken on a full size prolongation (approximately 4 in. diameter) and averaged from twenty-eight tests taken at random showed: Elastic limit, 130,000 lb. per sq.in.; ultimate strength, 142,000 lb. per sq.in.; elongation in 2 in., 20.5 per cent; reduction of area, 65 per cent; Izod, 67; Brinell, 303.

On a series of tests on 2 in. round, taken from the same type, after quenching in oil at 1,450 deg. F. and drawing as indicated we obtain:

Draw	Elastic	Ultimate	Elongation	Reduction	Brinell	Scleroscope
500	233,000	249,800	14.0	46.8	455	54
900	170,000	189,200	16.0	51.6	363	45
1000	161,000	180,700	18.5	58.3	344	43
1100	149,000	166,800	18.5	60.0	328	41

These results show that there is but slight change in physical characteristics between the 900 and 1,100 draws.

On type "MO. 102," an oil-hardened gear steel, we obtain a tensile strength in excess of 200,000 lb. per sq.in. for all drawing temperatures up to 1,000 deg. F. and an elastic limit in excess of 200,000 for all tem-

peratures up to 900. Tests on standard 0.505-in. specimens, quenched in oil at 1,450 and drawn at 400 and 1,000 deg. F. respectively, give:

Draw	Elastic	Tensile	Elongation	Reduction
400	302,000	336,600	10.0	22.4
1000	190,000	202,200	15.5	50.1

MECHANICAL MANIPULATIONS

The most important mechanical operations to which steel is subjected in the manufacture of the finished product are cold-pressing, forming and heading, and machining. Efficient response in the operations involving cold flowing of metal effects savings in fabricating costs resultant from minimization of rejections in semi-finished and finished parts, as well as maintenance costs on dies and tools. The merits of molybdenum steel for this purpose have been established through the results obtained on carbon-molybdenum and chromium-molybdenum types in the cold-forming and pressing operations in the manufacture of automobile frames, steel wheels and rear axle housings; through production of cold-headed parts on the chromium-molybdenum types, and through cold upset balls on the high-carbon, chromium-molybdenum ball and race types.

The molybdenum steels have better machinability than other alloy steels of equal physical properties. This has been established by the production results obtained on several thousand tons processed into rear axle drive shafts and on which no machining difficulties were experienced on shafts heat-treated to conform to a 300 to 340 Brinell specification. On a heat made by the United Alloy Steel Corporation for one of the large automobile companies and put into steering knuckles and front axles, we received a report to the effect that tool-grinding costs were but one-third as high as on 3½ per cent nickel steel of the same hardness and with corresponding shop production. Front axles with Brinells up to 340 maximum machined as well as chromium-nickel steel axles of 302 Brinell.

The scope of application of molybdenum steels appears wider than that of any of the other types of alloy steels. While the greater portion of the molybdenum steel manufactured to date has been used in automotive forgings and pressed metal parts, its excellent properties have likewise warranted its use in a variety of other parts, embracing railroad forgings and track bolts, armor plate, air flasks, agricultural implements, shovels, machinery forgings and piston rods, various edge tools, etc.

The general utility of molybdenum steels promises an increased demand in a well-diversified field.

Explosives in 1920

The total production (excluding exports) of explosives in the United States during the year 1920, according to reports that the U. S. Bureau of Mines has received from manufacturers, was 537,954,750 lb., an increase of 120,320,280 lb., or 29 per cent over the total output in 1919.

The production for 1920 is segregated as follows: Black blasting powder, 254,879,825 lb.; "high" explosives other than permissible explosives, 229,112,084 lb.; and permissible explosives, 53,962,841 lb. As compared with 1919, these figures represent an increase of 41 per cent for black powder, 15 per cent for high explosives and 39 per cent for permissible explosives.

The reports show that all classes of consumers used larger quantities of explosives in 1920 than in 1919, the principal increase being in coal mining.

Legal Notes

BY WELLINGTON GUSTIN

Principles of Shipping and Delivery of Goods Enunciated by Court Decision

The misdelivery of goods by the seller to a carrier other than the one named by the buyer completely exonerates the buyer from liability for loss of the goods, holds the Supreme Judicial Court of Massachusetts in a recent decision in an action brought by St. John Bros. Co. against Falkson, 130 N. E., 51. The decision involves some simple but important principles of shipping and delivery of goods.

The suit was one on contract to recover the price of a shipment alleged to have been sold and delivered by the company to defendant. It appears that the company received an order for the products at a stated price, "terms net ten days, to be shipped by freight via Metropolitan Line," that it be properly packed, addressed and made shipment to the buyer by the New England Steamship Co., but that delivery of same was never made to the buyer.

The company argued that on all the evidence it should have had a verdict, although the shipment was not made by the carrier designated by the defendant and although the goods were lost in transit. The defense was on the ground of the misdelivery to a carrier other than the one named by the buyer. The court said if there was nothing more the buyer would not be liable. And the company contended that the buyer had waived the right to stand on its defense of misdelivery.

The facts for this contention were that after the shipment of the products considerable correspondence passed between the parties; that in none of the letters written by the buyer did he make complaint or even refer to the fact that delivery had been made to the wrong carrier; that the buyer had received the bill of lading without protest as to the carrier named therein; that said buyer had made claim and brought action at law against the New York, New Haven & Hartford R.R., on two counts, one in contract for failure to deliver the goods, and the other for negligence in transportation, in each count the buyer herein describing himself as the consignee of the goods delivered to the carrier by the company, and which action is still pending. These facts were said to show a waiver as matter of law, but the court said that when more than one rational inference can be drawn from the evidence, a question of fact is presented, and the result is not a pure question of law.

WAIVER DEFINED

The court says: "Waiver is the voluntary relinquishment of a known right. It may be established either by words or conduct or both. It may be found to flow from all the circumstances as well as by express revelation of purpose." Whether there has been a waiver is usually a question of fact. Omission in his letters to the shipper to refer to the shipment by another carrier than the one named by him is not decisive. He was persistent throughout the correspondence in his denial of liability and in his refusal to pay.

Delivery of a non-negotiable bill of lading to the buyer of goods by the seller thereof, who shipped by an

unsanctioned carrier, and its retention by the buyer are not conclusive on the issue of waiver of his rights arising from the misdelivery, says the court. Possession of such bill of lading is of little significance as to title, for the carrier rightly could deliver to the consignee and discharge its liability without surrender of such a bill.

Further, the naming of the buyer of goods as consignee in a bill of lading, taken by the seller from a carrier not designated by the buyer, was some evidence that he was owner, but was not absolute proof; and an action at law, never brought to trial by the buyer, was not an unequivocal assertion of waiver of his right to rely on the seller's failure to perform its contract with him as to the selection by the carrier. This action may have been regarded as an attempt of the buyer to help the seller in tracing the goods or as founded on some other ambiguous design.

The effect of all these circumstances, the court rules, was not decisive to the effect that there was a waiver by the buyer of his right to defend on the ground of misdelivery. Whether there was a waiver was for the jury to decide.

Judgment for the buyer was upheld.

What Constitutes a Contract by Letters and Telegrams

A large volume of business is done by means of letters and telegrams, there being nothing else to express the contract between the parties. What is an offer and such acceptance to make a contract by means of such correspondence is not always clearly understood. In all cases there must be a complete meeting of the minds of the parties thereto on the subject matter of the negotiations, which means there must be an offer on the one side and a complete acceptance of that offer, without change or modification, to constitute a binding contract. To accept conditionally is not an acceptance, but a counterproposal or offer to the original offerer, which he in turn may accept or reject.

A recent decision of the Supreme Court of Arkansas relates to a contract for the sale of cottonseed oil in which letters and telegrams were used to confirm oral negotiations. The oil company sued to recover damages for defendants' refusal to deliver to it 100 tons of cotton seed which it had purchased from him. The agent of oil company claimed he had a conversation with the defendant and had purchased the cotton seed at \$37 per ton. Defendant claimed he should be allowed to draw draft for the full amount, but the agent said no, the balance would be paid when cars came with full weight. The agent then asked the defendant to confirm the sale by a telegram, which was sent as follows:

"I confirm sale of 100 tons cotton seed immediate shipment at 37 f.o.b. Conway."

The oil company replied by telegram stating it was mailing written instructions. The letter was confirmatory of the telegrams and the instructions authorized the seller "to draw for 90 per cent of the value of each car, with bill of lading and invoice attached to your drafts with the understanding you will guarantee shipping weight."

The defendant immediately wrote that he could not sign the confirmation of purchase sent him, for the reason that it contained a contract essentially different from the one he had offered to enter into. He stated that the contract agreed upon was that he should draw on the purchaser with bill of lading attached for the

full amount of the invoices, and that he should only guarantee the weights to be within one-half of one per cent of the weights shown by the invoices.

AGREEMENT MUST BE MUTUAL IN EVERY ESSENTIAL

Passing on the case, the Supreme Court said that a binding contract of sale may be entered into by letters and telegrams, and that an acceptance by letter or telegram of an unconditional offer, made in the same manner, will constitute an obligatory contract. It is equally well settled that before the contract is consummated each party must agree to the same proposition, and the agreement must be mutual to every essential term of the contract.

The oil company in its telegram of acceptance of the sale referred to its letter and the shipping instructions as a part of its acceptance of the offer made by the seller in his telegram. Hence they constituted a part of the negotiations, and it cannot be said that the two telegrams alone constituted a binding contract between the parties, said the court.

The limitation of the right of the seller to draw for only 90 per cent of the invoice price of the cotton seed and requiring him to guarantee the weights and quality at destination were different from those contained in the seller's telegram. The new terms as indicated in the letters prevented the telegram of the oil company from being an unconditional acceptance of the offer. The seller rejected the proposal contained in these letters as soon as he received them. Hence there was no meeting of the minds of the parties on the same terms.

Metal Protective Paints*

BY HENRY A. GARDNER†

THE causes underlying the corrosion of steel and the principles to be adopted in designing protective paints are well understood as the result of comparatively recent work.¹ In fact, the manufacture of the majority of high-grade paints now produced is based upon these principles. Briefly stated, they are as follows:

1. Basic substances in sufficient concentration inhibit the corrosion of iron. Basic pigments that are effective for this purpose are litharge, red lead, blue lead (basic lead sulphate), white lead, zinc oxide.

2. Chromic compounds (soluble bichromates), even in great dilution, prevent the corrosion of iron. Chromate pigments that are similarly effective when used in sufficient amounts are as follows: Basic lead chromate, normal lead chromate, zinc chromate.

3. Neutral substances that do not ionize to acid reaction are considered inert. So-called neutral or inert pigments, such as iron oxide, which do not excite corrosion, produce with linseed oil very durable films. Such pigments include black, brown and red oxides of iron, china clay, silica, talc, and barium sulphate.

4. Substances that form a galvanic couple with steel in the presence of moisture cause rapid corrosion. Pigments which act in this fashion (graphite, carbon black, lampblack) are used only as constituents of the finishing coats on steel surfaces, when first insulated from

the metal by a coat of basic or chromate pigment paint. These carbon pigments with linseed oil form very durable and water-resisting coatings.

PRIMER PAINTS

From the above data it is apparent that paints for priming steel should preferably be made of a substantial amount of one or more basic or chromate pigments, and that these paints should be covered with water-resisting finishing coats of carbon or iron oxide paints. For instance, steel that has been primed with high-grade red-lead paint and finished with two coats of a carbon paint will be protected from corrosion under most conditions for a long period of time.

In many instances, high-grade proprietary primer paints contain a mixture of red lead, chromate pigments, iron oxide and zinc oxide.

FINISHING PAINTS

The finishing coats of such paints contain carbon black or lampblack, generally with 5 per cent of litharge, and often certain amounts of iron oxide and silica. The liquid for such paints is raw or boiled linseed oil with a total of about 15 per cent of liquid drier, turpentine or mineral spirits. Where high gloss is desired, the addition of spar varnish is indicated.

In many places the use of black or other dark colored finishing paints may be objectionable from an aesthetic standpoint or because of their gloomy appearance. Light-gray paint made of white lead and zinc oxide, or of zinc oxide and barium sulphate (navy practice), tinted with lampblack, have been used as finishing coats on steel bridges, government structures and vessels. While possibly not as durable as red or black paints, they give much higher light-reflecting values and are of more pleasing appearance. For use around acid and chlorine factories, black bituminous coatings have usually been adopted. Of recent years, however, there has come a demand for white and light-colored paints. The only white opaque pigment for such paints that is insoluble in most acid gases is titanium oxide. This pigment, which is now produced by an electrochemical process and contains 25 per cent of titanium oxide precipitated on 75 per cent of barium sulphate, possesses tremendous hiding power. It is usually applied with up to 40 per cent of zinc oxide to give it sufficient hardness. In white or tints, such mixtures are very durable.

Various metal powders are now being applied to some extent as constituents of metal protective paints. When applied direct to steel surfaces, zinc powder and aluminum powder have much greater rust-preventing properties than the powders of other metals, on account of the high electro-positive nature of zinc and aluminum. Because of the great light-reflecting properties of aluminum powder, its use is indicated for special purposes on exterior work. Probably the most satisfactory liquid for suspending this powder is a high-grade exterior spar varnish. When used with linseed oil, a rather slow drying paint results.

CONCLUSION

Standard painting practice for iron and steel calls for the application of a primer containing basic or chromate pigments. Finishing coats generally contain red oxide or black carbon pigments. A wider use of white and light-tinted paints of high light-reflecting power is indicated for many purposes as finishing coats.

*Paper presented at the meeting of the American Electrochemical Society, Atlantic City, N. J., April 23, 1921.

†H. A. Gardner Laboratory, Washington, D. C.

¹Corrosion and Preservation of Iron and Steel—Cushman and Gardner; Paint Research—Gardner; Papers on Paint and Varnish—Gardner.

The Nature of Zinc Dust*

Complete Chemical Analysis of Zinc Dust From Retorts and Electric Furnaces—Five Hexagonal Crystals of Zinc Oxide Found—Briquetting Tests—Good Recovery of Metallic Zinc by Melting Under Salt Mixtures Containing Zinc Chloride

BY OYSTEIN RAVNER

AS AN additional study on the operation of electric distilling furnaces, supplementary to those on the Condensation of Zinc Vapor, appearing in CHEMICAL & METALLURGICAL ENGINEERING, Vol. 24, p. 885, May 18, 1921, some zinc dust from a smelter using electrothermic processes was secured, both from the ore furnaces and refining or redistillation furnaces. Analyses were as shown in Table I.

TABLE I. ANALYSES OF ZINC DUST

	From Spelter Furnaces, Per Cent	From Zinc Redistilla- tion, Per Cent	Met od of Analyses
Zn.....	40.10	76.61	Total Zn was determined by precipitation as ZnS, which was dissolved and electrolyzed (Treadwell).
ZnO.....	48.48	20.10	By determining the reducing action of the dust on a standardized potassium bichromate solution (Frankel). See Nissen "Die Untersuchungen metodes Zinks."
Pb.....	6.15	0.17	Electrolytically as PbO.
Fe.....	0.58	0.05	After precipitation with NH ₃ the precipitate was dissolved and titrated with N/20 KMnO ₄ sol.
Cd.....	0.09	0.07	Determined as sulphate according to H. Nissen, <i>Chem. Zeit.</i> 1906, p. 16.
As.....	0.05	0.01	The dust was dissolved in HCl, KClO ₃ added to avoid AsH ₃ and As determined by means of KBrO ₃ sol., according to A. Ledebur, "Leitfaden für Eisenhütten Laboratorien."
S.....	0.94	0.00	Determined as BaSO ₄ after fusion with soda and saltpeter.
Sb.....	traces	traces	
Insoluble and C.....	3.28	2.32	Spelter dust contained 0.10 per cent C and the zinc dust 0.22 per cent C.
			Determined as CO ₂ by wet combustion with CrO ₃ (Treadwell).
Nitride.....	0.34	0.33	
Water.....	0.37	0.24	
Total.....	100.38	99.90	

As a comparison, typical analyses from the smelter are given below:

	From Spelter Furnaces	From Zinc Redistillation
Zn, per cent.....	39.30	35.05
ZnO, per cent.....	48.50	55.30
Pb, per cent.....	9.45	7.60
	36.38	71.25
		75.39
		81.20
	6.50	25.09
		20.09
		12.86
		0.12
		0.15
		0.09

When these results are compared with analyses of zinc dust from retort furnaces, a great difference will be found.

The following analyses in Table II are taken from R. G. Max Liebig's "Zink und Cadmium" and from W. R. Ingalls' "The Metallurgy of Zinc and Cadmium."

OXIDE AND SULPHUR IN ELECTRIC FURNACE DUST

The great amount of sulphur and oxide in spelter dust from electric furnaces is remarkable. The sulphur was present principally as sulphide. However, there were traces of SO₄ radicle.

These facts may be explained as follows: The process

*Translated from *Tidsskrift for Berggræsen*, 1919, No. 11, p. 138. Portions of a dissertation prepared at the Institute of Inorganic and Physical Chemistry, Dr. P. Forup, director, Technical High School of Norway.

at the electrothermic smelters is continuous, while at the old smelters, using externally heated retorts, the process is intermittent. Moreover, the electric furnaces have a much greater capacity than the others. They require therefore much larger condensers, and the time

TABLE II.

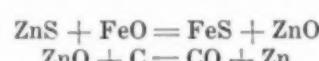
	Typical Analyses of Zinc Dust From Retort Furnaces	Zinc Dust of Commerce
Zn, per cent.....	84.46	86.95
ZnO, per cent.....	4.88	10.15
Pb, per cent.....	4.27	2.05
Cu, per cent.....	0.11	0.02
Cd, per cent.....	2.65	0.15
As, per cent.....	0.42	0.27
Sb, per cent.....	0.42	0.15
Fe, per cent.....	0.01	traces
S, per cent.....	traces	traces
Fe ₂ O ₃ , per cent.....	0.90	traces
Lime, per cent.....	2.46	traces
Magnesia, per cent.....	0.23	traces
Ins. + C, per cent.....	0.12	traces
SiO ₂ , per cent.....	0.22	0.22
	0.06	0.06

between distillation and deposition will consequently be much longer. The longer this time is the more carbon dioxide will be formed, according to the reaction:



and the carbon dioxide will form oxide with the zinc vapor. Cooling of the vapor should therefore proceed as quickly as possible.

The great amount of sulphur in the dust is due to the fact that the electric furnaces do not always use ore as low in sulphur as the old processes do. The following reactions take place at distillation temperatures.



At the high temperature employed, however, a little zinc sulphide may volatilize.

PHYSICAL PROPERTIES OF ZINC DUST

Dust from spelter furnaces was a powder of light gray color. Examination under a binocular microscope showed it to consist principally of a gray, homogeneous powder, among which small metal globules could be seen.

Dust from the redistillation furnace was a black powder with large and small globules of a metallic luster. By examination under the binocular microscope it was seen to consist chiefly of metallic globules of various sizes, together with a black powder, probably carbon from the electrodes. Some of the metallic globules were covered with a gray powder; others had a violet color.

Samples weighing 100 g. were taken and screen sized. As the grains in the powder were spherical, the diameter is given as representing the grain size, in Table III.

Particularly parts having a grain size between 0.6 and 0.13 mm. contained clear white crystals, which were picked out and examined. In one sample twelve

TABLE III. SIZING TEST OF ELECTRIC FURNACE DUST		
Grain Size	Spelter Dust, per Cent	Zinc Furnace Dust, per Cent
1—Grains over 1 mm.....	40.0	26.4
2—+1-0.6 mm.....	9.2	12.3
3—+0.6-0.3 mm.....	5.7	10.8
4—+0.3-0.13 mm.....	13.3	19.7
5—+0.13-0.09 mm.....	6.2	7.7
6—less than 0.09 mm.....	25.4	23.0
Loss.....	0.2	0.1
Total.....	100.0	100.0

particles were found. They were boiled for some time in concentrated hydrochloric acid, when four of the grains disappeared, while the remainder did not seem to be affected. The acid then showed the presence of zinc only. The insoluble residue from the hydrochloric acid solution was fused with soda, and tested qualitatively; SiO_2 , Al and Zn were found to be present.

In order to determine the composition quantitatively, as many crystals as possible were picked out, boiled in concentrated hydrochloric acid, washed and dried. Analysis then gave the following result: SiO_2 , 61.75 per cent; Al_2O_3 , 11.52 per cent; ZnO , 27.42 per cent.

Some of the grains were entirely transparent, others were not. Whether only one kind of crystals were present, or if there was a mixture of, for instance, zinc spinel, ZnAl_2O_4 , and quartz, could not be determined, as the crystals were small and incomplete and, moreover, occurred in such small quantities.

It seems peculiar that these crystals were found principally in the spelter dust and that they occurred only in sizes under 0.6 mm. This may be explained on the assumption that these particles were pulled from the charge during distillation. A much more violent generation of gas occurs in the spelter furnace, where ore and coke are charged, than in the refining furnace, where only zinc is distilled. It would therefore seem but natural that these crystals have their origin in the furnace lining, especially since they are found in small quantities in the dust from the redistillation furnaces.

In order to examine the crystals which were insoluble in hydrochloric acid more closely, some crystals from the lining of a zinc furnace were obtained. Some of these were found to be completely insoluble in concentrated hydrochloric acid, and the analyses proved them to consist of pure zinc oxide. According to determinations by Prof. J. Vogt, the crystals were hexagonal. ZnO occurring in nature has the same crystalline form.

SPECIFIC GRAVITY

In order to determine the specific gravity, the same apparatus as employed for determining the specific gravity of cement was used. The liquid used was turpentine and the increase in volume corresponding to a weighed amount of dust was read on a graduated neck. Dust from the spelter furnace weighed 5.81 g. per c.c., while dust from refined zinc weighed 6.10 g. per c.c.

BRIQUETTING EXPERIMENTS

An apparatus was used for these tests on which the corresponding volume was read directly for every pressure applied. The zinc dust was introduced into a hollow cylinder 8.8 cm. high of the best grade of axle steel, with a tight fitting piston of the best grade of tool steel. As the cross-section remains the same, the volume will be proportional to the height of the cylinder of zinc dust. Fig. 1 shows the compressibility graphically.

It was very difficult to get the briquets out of the

cylinder, as they adhered very strongly to it. The maximum pressure used was 1,500 kg. per sq.cm. This pressure compressed the dust from the redistillation furnace to 54.55 per cent of the original volume. When the pressure was released, the briquet expanded 0.2 mm., so that the final volume became 54.77 per cent of the original volume. The briquet had but little strength, and fell to pieces when taken out.

The maximum pressure of 1,500 kg. per sq.cm. corresponded to a volume of 51.14 per cent of the original volume of the dust from the spelter furnace. When the

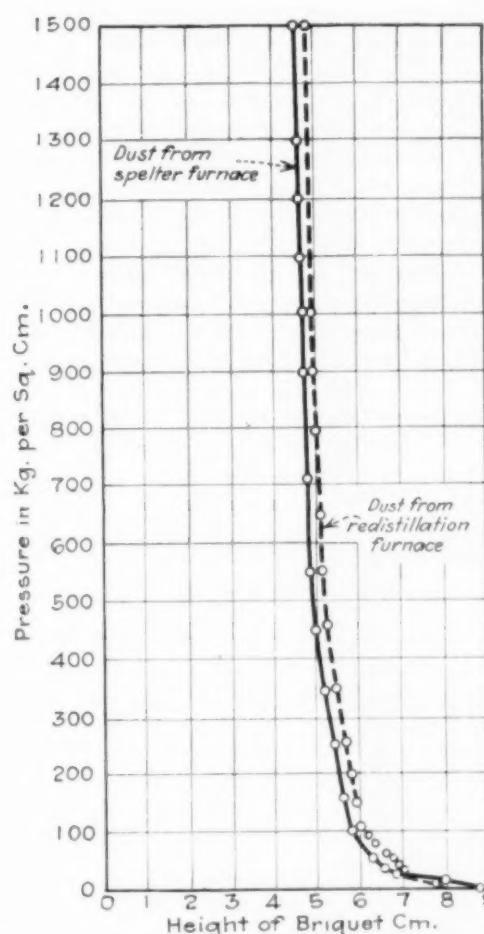


FIG. 1. VOLUME OF ZINC DUST BRIQUETS AFTER VARIOUS PRESSURES

pressure ceased, this briquet also expanded 0.2 mm., so that the final volume became 51.36 per cent of the original volume.

This briquet had more strength than the briquet of refined zinc dust. It weighed 4.35 g. per c.c.

As the specific gravity of the dust was 5.81 g. per c.c., the empty space per c.c. is:

$$p = 1 - \frac{4.35}{5.81} = 0.25$$

or a porosity of the briquet is still 25 per cent. It can probably be compressed considerably more by means of a sufficiently high pressure.

The dust was treated with oil before briquetting, but the strength was not improved thereby. However, briquets which contained a little tar or bituminous matter were considerably stronger.

CHEMICAL PROPERTIES

On account of its finely divided form, zinc dust is a powerful reagent. The use of zinc dust to effect reduc-

ing actions in organic chemistry is well known. Other less known reactions follow.

A mixture of one part zinc dust and two parts sulphur flowers burned like gunpowder when ignited. White fumes of zinc sulphide were given off, which compound was volatile at the temperature of this reaction.

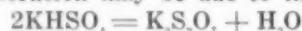
A mixture of dry zinc dust and iodine reacted violently when moistened with a drop of water.

Zinc dust has also pyrophoric properties. If it is heated in the air, it will ignite, and burns to oxide before it melts.

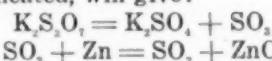
In order to melt together the metallic grains, the dust from the refining furnace which contained 76.61 per cent metallic zinc was heated in various molten salts or salt mixtures to exclude the air, in an attempt to cause the zinc to run together in the bottom, so that when this process was practiced on a large scale it would be possible to tap out the molten metal.

Forty grams KHSO_4 was melted and 20 g. dust added to the fused mass and stirred in to make it sink. A perceptible generation of SO_2 took place while the heating was continued, and after 10 minutes the melt was poured into an iron button mold. The zinc dust had collected at the bottom, but the zinc had not run together.

The SO_2 generation may be due to the reactions:



and this, when heated, will give:



The zinc will therefore be gradually oxidized.

An attempt was then made to melt the zinc by keeping the dust in a molten mixture of NaCl and Na_2CO_3 , but the dust remained as such in the bottom. A mixture of NaCl and CaCl_2 gave the same result.

A melt, however, of 50 g. ZnCl_2 + 50 g. NaCl , to which 50 g. zinc dust was added, gave a zinc button which after having been washed in hot water and dried weighed 31.2 g. As the zinc dust holds 76.61 per cent metallic zinc, the recovery was 81.44 per cent. To the melt from the preceding test, 5 g. zinc dust was again added, and 33.5 g. zinc was obtained, giving a recovery of 87.71 per cent.

A melt of 50 g. CaCl_2 and 50 g. ZnCl_2 with 50 g. zinc dust added gave a zinc button which weighed 35.1 g., or a recovery of 91.62 per cent.

According to these tests, it seems that ZnCl_2 should be present in order to melt the zinc. This may be explained by saying that ZnCl_2 dissolves zinc oxide, thus freeing the metallic zinc and enabling it to coalesce. Further confirmation of this idea may be found in the fact that the recovery, when treating dust from the spelter furnace which contained more oxide, was not even approximately as high if the amount of zinc chloride in the melt was not increased proportionately.

Organization of Workers in Germany*

IN GERMANY, as in all countries affected by the war, the power of labor and especially of organized labor has increased considerably. In order to secure an uninterrupted supply of war materials concessions without end had to be made to the working classes. The greatly augmented power of the working classes which was acquired during the war underwent an even more extraordinary increase during two years following the armistice. The most distinguished feature of this vastly increased power of labor is to be found in the development of the trade unions, particularly of the so-called "free" trade unions.

The most important groups of the German trade unions are the "Free," the Christian, the Hirsch-Ducker, the Syndicalist and Communist, and the so-called "Yellow Unions." The development of the German trade union movement has repeatedly been discussed in publications of the Bureau of Labor Statistics. For this reason and owing to lack of space only a very sketchy description of the development of the individual trade union groups is given below.

THE "FREE" TRADE UNIONS

The "free" or Social Democratic trade unions (*Freie Gewerkschaften*) embrace the great majority of the organized workers in Germany, and constitute the most highly organized labor organization in the world. At present the number of members is over 7,000,000. The movement was started in the '60s of the last century, mainly by members of the Social Democratic Party. By 1874 the early unions, which were viewed with dis-

favor by the government, had died out. Attempts were made to revive them, but the anti-socialist law of 1879 destroyed not only socialist bodies but also practically all trade union organizations. Between 1878 and 1888, 108 trade unions were dissolved by the authorities; but in spite of that, many unions contrived to keep alive under the form of mutual benefit societies, so that, when the anti-socialist law lapsed (it was never repealed), a large number of unions were in existence in a more independent form than before, though the members were still pledged to work for the Social Democratic Party.¹

In 1890 it was decided to link up the unions in a central organization, and at a conference in Berlin the General Commission of German Trade Unions was founded. This conference also decided on the form that trade union organization should take, that the real power should be left with the national federations, which still remain the strongest and most characteristic element in German trade union organization. Until the tenth congress in July, 1919, the central co-ordinating agency was the General Commission, with its headquarters in Berlin. It consisted of a committee of thirteen members, elected by delegates of the trade federations, meeting every three years at a trade union congress. Its functions were to carry on general trade union propaganda and publish trade union statistics. It also issued the *Korrespondenzblatt*, the weekly organ of the Social Democratic unions.

In 1913 there were 2,548,763 members of the "free" trade unions in forty-seven organizations. Each of the unions had its own journal. The local branches and district organizations are very closely supervised by the national executives of the unions. The local branches of the unions are federated in "cartels" (*kartelle*) which correspond more to the British trade councils and the

*From *Monthly Labor Review*, vol. 12, No. 3, March, 1921, p. 131.

See "Organization of Employers in Germany," *CHEM. & MET. ENG.*, vol. 24, No. 20, p. 889.

¹*Labor Overseas*, vol. 1, No. 1, p. 116; London, 1920.

American central labor unions than to the French bourses du travail or the Italian chambers of labor. They do, however, manage strikes in their own districts. The secretary of the cartel is very often in charge also of the local labor secretariat (*Arbeitersekretariat*).

At the tenth trade union congress at Nuremberg in July, 1919, a complete reorganization took place. The General Commission was abolished, and the General Federation of German Trade Unions (*Allgemeiner Deutscher Gewerkschaftsbund*) was constituted. Its aim is to "form a permanent means of co-operation between the affiliated unions in representing the common interests of all workers organized in trade unions." The federation has an executive committee consisting of fifteen members elected by, and responsible to, the congress. The former council is replaced by the federation committee which consists of one member of the executive committee of each of the central unions (generally the president). The cartels are now known as local committees.

ACTIVITIES OF THE FREE TRADE UNIONS

When the war broke out the unions made a truce (*Burgfriede*) with the employers, and their services were entirely at the disposal of the government. They co-operated with the employers in joint councils (*Arbeitsgemeinschaften*) and greatly extended the system of collective agreements. At the revolution they took no part in political action. Friction soon developed between them and the workers' councils (*Arbeiterräte*) owing to attempts to exclude the unions from influence in the councils.

The split in the Social Democratic party naturally brought about a division in the unions. The trade union congress in July, 1919, declared its political neutrality owing to this division. At this congress the "patriotic" attitude of the General Commission was sharply criticized, but a vote of confidence was ultimately passed. There is a strong revolutionary minority in the federation which has captured the powerful Metal Workers' Union and the Berlin Trade Union Commission. This minority is opposed to all negotiation with employers, and the joint council in the metal trades has been dissolved. The majority is in favor of a wide extension of joint councils in preparation for "the social state." The majority leaders maintain that works councils, if they are to be successful, must not be more than the organs of the unions within the various establishments, while the minority hold that they must be revolutionary agencies.

The most interesting event in recent trade union history was their entrance into the political field at the time of the Kapp coup in March, 1920. The unions organized a general strike against the usurping junker government, with the co-operation of both the majority and the independent socialists and with the approval of the public; their action was the chief cause of Dr. Kapp's failure. The federation declared that the struggle would be continued until the government granted a list of demands which included trade union "influence" over the reorganization of the government, social and economic legislation and the resignation of Herr Noske, Minister of Defense. Although the concessions made by the government were not wholly satisfactory to the unions, it is significant that such demands were made. Before the war, the unions, while closely connected with the Social Democratic party and believing in the class war, had held that all such questions should be left to

the political party, and that the immediate business of the unions was to work for improvement in the position of the workers, mainly by means of better wages and working conditions. They were active in encouraging international co-operation, and in pre-war times the great majority of the international trade union federations had their headquarters in Germany.

THE CHRISTIAN UNIONS

The religious trade union movement was first co-ordinated about 1890 in opposition to the socialism and militant methods of the "free" unions. There are three branches, the Christian, the Catholic and the Evangelical. They are strongest in the industrial and mining districts of Rhenish Westphalia, where the Catholic Church is very influential, and in Bavaria. In 1899 a Federation of Christian Trade Unions of Germany was formed to admit members of any Christian denomination. Its aims were stated to be to promote the common interests of employers and workers and to increase production. Its methods were to be conciliatory, the strike to be admitted only as a last resource. Occasionally they have co-operated with the "free" unions for common, strictly economic ends.

In 1919 a federation was formed called the German Trade Union Federation composed of the "Christian" unions, the Trade Union of Non-Manual Workers and the Union of German Officials. The membership was stated to be 1,700,000 at the end of 1919. The unions forming the new body were stated to be inspired by the conviction that not class warfare and internationalism but national consciousness and the fostering of the ideals of the German people were the right path for the future.

HIRSCH-DUNCKER UNIONS

The Hirsch-Duncker unions date from about 1868 and were due mainly to the efforts of Dr. Marx Hirsch, who drew his inspiration from the English trade unions of that period. They were meant partly to counteract the influence of the Social Democratic unions which were then springing up. They were originally political and economic associations of workingmen more or less in sympathy with the radicalism of their founder. At their congress in 1906 they declared themselves to be "neutral organizations for economic ends." They believe that the interests of employers and workers are fundamentally the same and that concessions must be obtained by agreement and not by aggressive methods, and without political action. At their congress in 1908 their aims were defined as the repudiation of class warfare and community of property, support of arbitration and conciliation in preference to strikes, and the establishment of collective agreements. At the end of 1919 they had only 188,831 members and, though this number has probably grown with the general spread of trade unionism, they have no great significance in the German labor movement.

SYNDICALIST AND COMMUNIST UNIONS

Syndicalism in Germany is organized in the associations centralized in the Free Workers' Union of Germany. They are described in the journal of the Metal Workers' Union (itself extreme), as "extremist organizations whose principles are those of class war." They are strongly opposed to social democracy. Before the war they were known first as the Federation of Syndicalists and later as the Free Association of German

Trade Unions. Since then the name has been changed several times, the name Free-Workers' Union of Germany (*Freie Arbeiter-Union Deutschlands*) being adopted at the congress in December, 1919, as many workers in Germany are shy of the name of syndicalism. In some districts they are known as "localists." The writer in the *Metal Workers' Journal* states that numerically they are not strong; they had 15,000 members before the war and 110,000 at the end of 1919. A delegate at the 1919 congress said that progress had been rapid in the Ruhr district, where 90 per cent of the miners were organized in syndicalist organizations.

As the contributions exacted by the union are very low, it is unable to finance strikes successfully and prefers to adopt "ca'canny" methods and passive resistance, in order to reduce output to such an extent that the employer may be compelled to shut down his factory. The state, it is believed, would then have to hand over the establishment to the workers.

The General Workers' Union (*Allgemeine Arbeiter-Union*) is a communist organization and is the outcome of the dissatisfaction felt by the workers with the "reactionary and bourgeois" tendencies shown by some trade union leaders. Opposition to trade unions was strengthened by rumors that the Russian Communists were unfriendly to the unions and that there was no room for the latter in a soviet republic. It was asserted that there should be only one proletarian organization, whose aim should be the conquest of political power.

The Communist party refused to support these ideas, but, when the Communist Labor party was formed at Berlin in April, 1920, it refused to recognize the trade unions, because they were willing to co-operate and make compromises with capitalism.

AIMS OF SYNDICALIST AND COMMUNIST UNIONS

The most prominent feature of the bylaws of the General Workers' Union is the antipathy shown toward the Social Democratic trade unions. The union is organized on the basis of works organizations. Workers in one establishment form a "union" under the leadership of the works council. This union works in close co-operation with the Communist Labor party. Its aims are (1) to destroy the trade unions, and (2) to prepare for the communist system.

Thus the syndicalist free union and the communist general union differ widely, the former aiming primarily at industrial conquest and the latter at political supremacy. They are at one, however, in attacking official trade unionism as bureaucratic. In their opinion leaders are unnecessary, and their own spokesmen have no position of authority and no responsibility. The free union attacks all forms of centralization, and accuses even the general union of a tendency toward centralization through its co-operation with the Communist Labor party.

"YELLOW" UNIONS

The so-called "yellow" workers' movement in Germany was promoted before the war by large firms, such as Krupp's and Siemens'. The total membership before the war was 280,000. During the war their membership decreased and in a national agreement between the largest employers' organizations and all of the large workers' central organizations, concluded on Nov. 15, 1918, it was expressly stipulated that employers must sever all connection with the movement. In an article in *Freiheit* (Berlin, July 2, 1920), Herr Aufhäuser,

president of the Federation of Social Democratic Unions of Technical and Office Employees and a member of the National Economic Council, states that the "yellow" movement is being revived. The new organizations are the National Federation of German Trade Unions (*Nationalverband Deutscher Gewerkschaften*) and the National Federation of Technical Employees (*Nationaler Bund Technischer Angestellten*). They are stated to be subject to the influence of Herr Karl Friedrich von Siemens (president of the Siemens Co. and one of the leaders of the Democratic party). The actual leader of the movement is Herr Geisler, a Reichstag Deputy of the People's party. The above unions are organized in industrial groups with the avowed object (as stated in Herr Geisler's journal the *Deutsche Arbeitgeberzeitung*) of "obtaining the strongest possible representation in the works councils and of making the latter organs of increased production instead of organs of the bolshevization of the German life."

Gasoline Engine Shovel

Announcement of considerable interest to contractors and chemical engineers as well as the clay products industry comes in the nature of a new gasoline engine shovel, manufactured by the Austin Machinery Corporation of Chicago. This shovel, as shown in the



NEW GASOLINE ENGINE SHOVEL

accompanying illustration, is not a makeshift adaptation, but an entirely new design built for gasoline operation. Air-controlled clutches enable the operator to manipulate with ease, and the cushion drive clutches of the swinging and crowding devices insure the necessary overlapping of operations. All movements may be quickly reversed at any time. The swinging machinery and hoisting drums are locked by means of automatic brakes when the power is shut off. Other features of the machine include a three-lever digging control, a "slam the dipper" door, insuring a clean dipper; a power boom hoist, quick replacement of clutch bands, and interchangeability of clutch parts.

Determination of Spelter by Measuring the Hydrogen Evolved

The Kauffman-Lattimer Co., manufacturer of scientific apparatus at Columbus, Ohio, has just put on the market the Cushman Coating Tester which has recently been designed by Dr. A. S. Cushman.

The determination of the weight and spelter coating by this method is based upon the action of hydrochloric acid upon the galvanized coating, collecting and meas-

uring the hydrogen gas evolved. The weight of coating may be determined upon flat sheets, corrugated sheets and formed culverts, by the use of differently shaped rings provided with the apparatus. The coating upon wire can be determined by placing a definite length of wire under the flat ring on a glass plate.

The metallic rings used are made of nickel, tinned iron or other acid-resisting metal and are fitted with No. 12 three-hole rubber stoppers. A measuring burette and leveling bottle are provided for collecting and measuring the hydrogen evolved.

The number of cubic centimeters of hydrogen measured at 20 deg. C. (68 deg. F.) multiplied by the factor provided with each ring will give the ounces of spelter coating per square foot of actual surface on one side of the culvert. By doubling this figure the coating in ounces per square foot of sheet surface can be obtained.

Recent Chemical & Metallurgical Patents

British Patents

Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Extraction of Hydrocarbons.—A mixture of sulphur dioxide and a ketone, such as acetone, is used for the extraction at ordinary temperatures of hydrocarbons from coal and for the separation of unsaturated from saturated hydrocarbons. Other ketones which may be employed are methyl ethyl ketone, diethyl ketone, methyl propyl ketone, and ethyl propyl ketone. The extraction may take place under pressure. According to examples: (1) Acetone is saturated with sulphur dioxide and allowed to remain at atmospheric temperature and pressure in contact with pieces of hard coal; by steam distillation of the reddish liquid produced a yellow oily hydrocarbon is obtained. Increasing the pressure gives a larger yield of the product; an apparatus is described in this connection. (2) The extraction of lignite or bituminous brown coal with the acetone-sulphur dioxide mixture yields a resinous wax-like substance, which apparently results from the action of the sulphur dioxide on the lignite and the solution in the acetone of the product. The lignite may previously be treated under pressure with alcoholic or aqueous caustic alkali and the residue after evaporation used for the acetone-sulphur dioxide treatment. (3) Crude naphtha, when extracted with the acetone-sulphur dioxide mixture, separates into two layers, the clearer of which, after evaporation of the acetone and sulphur dioxide, yields unsaturated hydrocarbons; the paraffine hydrocarbons remain in the other layer, being undissolved by the acetone-sulphur dioxide mixture. (4) The acetone-sulphur dioxide mixture is used for absorbing diolefines, and thereby separating them from other hydrocarbons employed or produced in their manufacture; an addition product of the diolefin and sulphur dioxide is apparently formed at ordinary temperatures, and this splits up on heating. (Br. Pat. 156,123; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. March 2, 1921.)

Chlorinated Hydrocarbons.—Chlorinated hydrocarbons of low boiling point are obtained by cracking oils of comparatively high boiling point in the presence of chlorine or hydrochloric acid. Steam may be introduced into the reaction; a contact material, such as quartz, porcelain, platinum and like metals, or metallic chlorides, may be present; and the reaction may take place under increased pressure. Specified starting materials are petroleum, mineral oils, solar oil, mazut, tar oils, resin oils, paraffine oil, and Galician or Roumanian gas oils. By elimination of chlorine from the products, diolefin hydrocarbons can be obtained. According to examples: (1) Equal parts of petro-

leum vapor, hydrochloric acid gas and steam are passed through a tube heated in a furnace. After condensation of the product and neutralization with lime, a mixture of hydrocarbons and chlorinated hydrocarbons is obtained, which can be separated by distillation. (2) Tar oil and hydrochloric acid or chlorine gas are passed over a white hot platinum spiral in an apparatus resembling an isoprene lamp. The high boiling fraction of the product is again passed through the apparatus, and the low boiling fraction of chlorinated hydrocarbons allowed to accumulate. (3) A mixture of an atomized gas oil and hydrochloric acid is forced into a heated retort. (4) A mineral oil is heated under pressure with concentrated hydrochloric acid solution in an autoclave, and after some hours the product permitted to distill over into a vessel containing lime. The chlorinated hydrocarbons deposited are then purified by fractional distillation. The reaction is facilitated by the presence of small quantities of chlorides, such as calcium, zinc, magnesium, aluminum, manganese or tin chloride. (Br. Pat. 156,139; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. March 2, 1921.)

Edible Yeast Preparations.—To improve the taste of yeast and to render it more digestible it is treated with hydrogen under heat and pressure. It may first be treated with a solution containing ammonium or sodium carbonate or borax and washed to remove the bitter flavor, and disintegrated in any known way. It is then treated with hydrogen at a pressure of 100 to 200 atmospheres and a temperature of 100 to 130 deg. C. The liquid thus obtained may be used directly, mixed with fats or oils to form an artificial milk, or dialyzed by electro-osmosis or otherwise to remove salts. The action is facilitated by the presence of small quantities of sodium chloride, or organic acids such as formic, acetic, tartaric or citric acid. The yeast may also be first reduced to a dry powder and treated with hydrogen in this state. Catalysts such as nickel or palladium may be employed in masses, but not as powder. Higher temperatures and lower pressures may be employed, in which case the yeast must be washed after treatment. (Br. Pat. 156,153; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. March 9, 1921.)

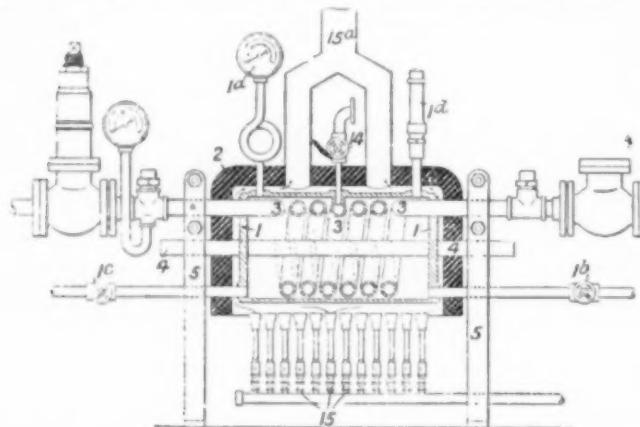
Anthraquinone.—Anthraquinone is prepared by oxidizing anthracene, preferably dissolved or suspended in a liquid medium, by means of oxygen or an oxygen-containing gas in the presence of an oxygen carrier. Thus, oxygen is passed under pressure into a hot mixture of anthracene and acetic acid containing a little fuming sulphuric acid, or oxygen containing a small percentage of nitrous gases is introduced into a hot mixture of anthracene and acetic acid containing cobalt nitrate. Similarly, anthracene sulphonic acids can be oxidized to the corresponding quinone compounds. (Br. Pat. 156,215; not yet accepted; CHEMISCHE FABRIKEN WORMS AKT. GES., Frankfurt-on-Main, March 9, 1921. See also Pats. 156,538 and 156,540.)

Tanning.—A tanning process consists in the use of mixtures of heavy metal salts of lignin-sulphonic acids from waste sulphite liquors, with salts of other organic or inorganic acids such as sulphuric, formic, lactic acid, etc., and with or without addition of other tanning or non-tanning agents. The mixed salts precipitate glue and are stated not to flocculate in dilute aqueous solutions. The following examples are given: (1) Tanning is effected with a liquor containing about 2 to 3 per cent of tanstuff prepared by decomposing an aqueous solution of 100 kg. of sodium lignin-sulphonates with 100 kg. of crystallized aluminum sulphate. The solution may be used directly or evaporated to dryness. The leather obtained is then stuffed and dried. (2) Tanning is effected as in example 1 with a tanstuff prepared by decomposing 100 kg. of calcium lignin-sulphonates with 170 kg. of crystallized ferric sulphate, the calcium sulphate being filtered off. (Br. Pat. 156,186; not yet accepted; CHEMISCHE FABRIKEN WORMS AKT. GES., Frankfurt-on-Main. March 9, 1921.)

Catalytic Oxidation of Hydrocarbons.—Hydrocarbons are oxidized to aldehyde, ketonic or carboxylic compounds by passing a mixture of their vapor with oxygen over a catalyst of a non-basic character maintained at a temperature below red heat. Suitable catalysts are vanadic acid,

molybdic acid, and salts of uranic or chromic acid, distributed over a support, such as pumice. In this way anthracene is converted into anthraquinone; aromatic hydrocarbons with side-chains give a mixture of aldehyde and acid—e.g., toluene yields benzaldehyde and benzoic acid; and unsaturated hydrocarbons of high molecular weight are converted into acids. (Br. Pat. 156,244; not yet accepted; A. WOHL, Dantzig. See also Pat. 155,245. March 9, 1921.)

Acetaldehyde; Acetic Acid.—Acetaldehyde is produced by hydrating acetylene with steam under pressure and at a fairly high temperature. The reaction is facilitated by the presence of small quantities of acids, such as acetic acid, sulphuric acid, nitric acid, phosphoric acid and organic sulphonate acids, acid anhydrides or sulphur acids. Inert gases or vapors may be employed as diluents. The apparatus comprises a pressure chamber 1, surrounded by an insulating



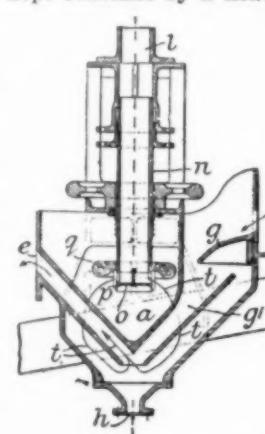
jacket 2 and supported on legs 5 above a battery of gas burners 15, the hot gases from which pass between the chamber and the jacket to the flue 15a. The chamber 1 contains the reaction spiral 3, a pyrometer tube 4, and is fitted with steam inlet and outlet pipes 1b, 1c, a manometer 1d and a safety valve 1e. The reaction tube 3 is made of steel, iron, nickel steel, aluminum steel, nickel copper, ferrosilicon, nickel covered with gold or of steel or other metals covered with platinum, iridium, osmium, gold, etc., or with an acid-resistant enamel. The mixture of acetylene and steam in equal volumes is forced through the reaction tube, heated to 250-300 deg. C. at a pressure of 5-10 atmospheres. The product is condensed, and the unchanged acetylene again circulated through the apparatus. The catalytic acid may be mixed with the reacting gases before passing into the apparatus. Acetic acid is obtained by introducing sufficient oxygen or air through the pipe 14 into the middle of the reaction tube 3. (Br. Pat. 156,152; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. March 9, 1921.)

Acetaldehyde; Acetic Acid.—Acetaldehyde or acetic acid is prepared by forcing acetylene through a conductive porous anode, the pores of which are filled with an insoluble mercury compound. The electrolytic bath being acidic, the mercury compound is continuously regenerated by anodic oxidation. The bath is maintained at such a temperature that the product is continuously distilled off, and the pressure may be reduced to facilitate the distillation. If the potential difference between the electrodes be maintained below the decomposition potential of water simple hydration of the acetylene to acetaldehyde takes place; whereas with a potential difference above the decomposition potential of water the acetaldehyde produced is immediately oxidized to acetic acid. A suitable electrolyte is phosphoric acid, and the anode may be formed of wire netting, or perforated or corrugated sheets made of iron, steel, nickel, nickel steel, ferrosilicon, iron-nickel or iron-aluminum alloys, or copper coated with platinum or gold. The mercury compound—e.g., mercurous oxide or mercury phosphate—may be employed as such, or mixed with oxides, peroxides or porous fibrous substances such as asbestos, paper, thread, wool or cellulose ester powder, with or without binding agents. An apparatus is described. (Br. Pat. 156,147; not yet accepted; H. PLAUSON, Hamburg, and J. A. VIELLE, Westminster. March 2, 1921.)

Preparation of Cellulose.—In the preparation of cellulose from ligneous plants and plant fibers, such as jute, hemp, manila, "cotton," reeds, bamboo, esparto and the like, the materials are digested with weakly alkaline or neutral lye containing one part of an alkali acetate and two parts of an alkali sulphite under pressure. Other inert salts may be present. The waste liquor may be acidified with sulphuric acid or sodium bisulphite, and a mixture of sulphurous acid and acetic acid boiled off, the residual liquor being evaporated to dryness and incinerated to produce a raw soda lye which may be converted for re-use by adding the mixture of sulphurous and acetic acids boiled off. The waste liquor may be treated with caustic lime and then with sodium sulphite, a solution of sodium acetate being obtained and calcium monosulphite and sulphite precipitated. Sulphurous and acetic acids may be obtained from the monosulphite and acetate and used for the preparation of fresh lye. (Br. Pat. 156,512; not yet accepted; M. MULLER, Finkenwalde, Germany, and O. HEIGIS, Pilsen, Bohemia, March 9, 1921.)

Removing Carbon From Iron and Other Metals or Alloys.—In a process for removing carbon from iron and other metals or alloys by means of oxygen, the admission of oxygen is regulated in such a manner that only so much metal oxide is formed as can again be reduced by the active carbon present so that oxidation and reduction take place at practically the same rate and at the same time. The bath in which the operation takes place is externally heated and maintained at a temperature not exceeding the melting point of the metal or alloy under treatment. The oxygen is admitted by means of inclined nozzles of small cross-section so that the bath is given a circulating movement by the action of the impinging gases which may also heat the bath. The oxygen may be used in the pure state or as air with or without admixture with oxygen or other gases. Thus the carbon is removed without any appreciable loss of substances such as manganese, chromium, silicon, etc. (Br. Pat. 156,548; not yet accepted; H. SCHUTZ, Düsseldorf. March 9, 1921.)

Upward Current Ore Classifiers.—The upward current is obtained by means of a head of water in the apparatus kept constant by a float and also independently adjustable.



accepted; E. P. F. JALABERT, Constantine, Algeria. March 9, 1921.)

Nitric Acid.—In the preparation of concentrated nitric acid by the absorption of nitrous gases in strong sulphuric acid, the nitro-sulphonic acid thereby produced is decomposed by means of vapors of watery nitric acid. The latter, together with a gas, preferably containing oxygen—for instance, air—are passed into the bottom of a tower packed with acid-resisting material, down which the nitro-sulphonic acid is allowed to flow. Nitrous gases and vapors of nitric acid are evolved. The latter, on condensation, form red fuming nitric acid, while the former are condensed in water and used for decomposing further quantities of nitro-sulphonic acid. The nitrogen oxides obtained by passing air through the fuming nitric acid to decolorize it are similarly employed. The concentration of the denitrated sulphuric acid is 80 per cent. Br. Pat. 156,800; not yet accepted; NORSK HYDRO-ELEKTRISK KVAELSTOFAKTIESELSKAB, Christiania, March 16, 1921.)

Current Events

in the Chemical and Metallurgical Industries

Program of the Detroit Meeting of the A.I.C.E.

The thirteenth semi-annual meeting of the American Institute of Chemical Engineers will be held at Detroit, Mich., June 20 to 25 inclusive. A party of members from the East will leave New York for Albany on the Hudson Night Line at 6 p.m., Saturday, June 18, and take the Sunday night Detroit and Chicago boat sailing at 6 p.m. from Buffalo to Detroit, arriving there Monday at 8:30 a.m.

MONDAY, JUNE 20

Meeting at Hotel Statler

9 a.m. Business sessions, reports of council, officers and committees.

"Possible Developments of the Chemical Engineering Catalog," Dr. William M. Grosvenor.

10 a.m. Reading of papers.

Address of welcome by the Hon. James Couzens, Mayor.

"The Chemical Engineer and the Auto Industry," C. F. Kettering, chief of research, General Motors Corporation.

"The Manufacture and Application of Automobile Finishes" (illustrated), Dr. C. D. Holly.

"Monel Metal," W. M. Corse, general manager, Monel Metal Products Corporation.

"Manufacture of Pyroxylin Artificial Leather," G. C. Given.

12:30 p.m. Luncheon, Hotel Statler, \$1.25.

2 p.m. Excursion. Inspection of plant of the Cadillac Motor Co., Michigan Ave. special car.

5:30 p.m. Leave Hotel Statler for Boat Club, D. U. R. and Boat Club ferry.

6:30 p.m. Dinner dance at Detroit Boat Club. Informal, complimentary.

TUESDAY, JUNE 21

8 a.m. Leave by special interurban cars for Ann Arbor, Mich.

10 a.m. Inspection of laboratories and campus, University of Michigan.

12:30 p.m. Luncheon at Michigan Union, complimentary. Address by President M. L. Burton.

1:30 p.m. Reading of papers.

Address of President Wesson.

"The German and American Haber Synthetic Ammonia Plants" (illustrated), R. S. Tour, chief engineer, Nitrate Division, Ordnance Department, Washington, D. C.

"The Motor Fuel Situation," E. H. Leslie, associate professor chemical engineering, University of Michigan.

"The Relation of the Chemical Engineer to Highway Engineering" (illustrated), A. H. Blanchard, professor highway engineering and highway transport, University of Michigan.

"Evaporator Design," W. L. Badger, professor chemical engineering, University of Michigan.

"Control of Ferrous Materials in the Auto Industry," A. E. White, director department of engineering research, University of Michigan.

"Some Problems in Non-Ferrous Metallurgy," Dr. J. H. Ransom, chief of research, Michigan Smelting & Refining Co.

6 p.m. Dinner at Michigan Union, \$1.50.

8 p.m. Return by special interurban cars to Detroit. Those who wish to return to Detroit earlier may take the cars at 5 p.m.

WEDNESDAY, JUNE 22

9 a.m. Excursion. Leave by special cars for Ford River Rouge plant, D. U. R.

12 noon. Return to Detroit by special cars.

1 p.m. Luncheon at Board of Commerce, \$1.25.

3 p.m. Cars to ferry and Belle Isle Ferry to Walkerville. Inspection of plant of Hiram Walker & Sons, Ltd., Walkerville, Ont.

6 p.m. Barbecue on shores of Lake St. Clair, complimentary.

9 p.m. Return to Detroit.

THURSDAY, JUNE 23

8 a.m. Half-day boat trip, steamer Britannia.

12 noon. Return to Detroit.

2 p.m. Meeting at Hotel Statler. Reading of papers. "Heat Treatment of Steel," W. A. Gatward, engineer, Hoskins Manufacturing Co.

"The Future of Aeronautics," W. B. Stout, chief engineer, Stout Engineering Laboratories.

"More Miles Per Gallon," O. C. Berry, chief engineer, Wheeler-Schebler Carburetor Co.

"The Determining Factors for the Life of a Pneumatic Tire," William G. Nelson, chemist, Morgan & Wright.

"A New Spray Nozzle for Acid Work," James R. Withrow.

"Evolution of the Glue Industry and Grease Extraction," Ludwig A. Thiele.

7 p.m. Subscription Dinner, Hotel Statler (informal), \$5.

FRIDAY, JUNE 24, AND SATURDAY, JUNE 25

Optional visits to manufacturing plants:

1. Diamond Crystal Salt Co., St. Clair. Trip will be made on Friday, June 24, boat leaving at 8 a.m. and returning in the evening. The plant of this company is the most modern and up-to-date of its kind in the world.

2. Parke, Davis & Co. Large plant.

3. Michigan Smelting & Refining Co.

4. Hoskins Manufacturing Co.

5. Acme White Lead & Color.

6. Detroit Edison Co., Conners Creek plant.

7. Morgan & Wright Co.

8. Detroit City Gas Co.

9. Dodge Bros. Motor Car Co. Fine plant.

10. Berry Bros. Paint and Varnish Manufacturing Co.

11. Schmidt Tanning Co.

12. Trus-Con Laboratories.

13. Detroit Sulphite & Paper Co.

14. Ford Motor Co.

15. Inland Delray Salt Co.

16. Pennsylvania Salt Co.

17. Michigan Stamping Co.

18. Burroughs Adding Machine Co.

19. Parker Rust Proof Co. of America.

Corrosion of Duralumin Sheet

An inspection has been made of corroded duralumin in the form of thin sheets used in the construction of all metal airplanes. The material became brittle in service owing to the development of intercrystalline "cracks" evidently as a result of corrosion. The attempt was made to produce the brittle condition in portions of the sheet which apparently were still ductile. By corrosion alone, as well as by the simultaneous action of corrosion and stress, it was possible to develop intercrystalline brittleness in the specimens. Annealing of the material, annealing followed by slight cold-rolling and severe cold-rolling of the commercial stock did not appear to affect materially the corrosion. In this case it appears certain that the deterioration was the result of the corrosion of the sheet. Brittleness developed because of corrosion from both acid and neutral solutions, but an alkaline attack did not appear to cause the development of brittleness.

Sodium Compounds in 1920

The production, imports and exports of sodium compounds all increased in the United States in 1920 over 1919, according to figures compiled by R. C. Wells, of the United States Geological Survey, Department of the Interior.

The sales of all sodium compounds and of metallic sodium amounted to 9,886,020 tons, valued at \$139,336,338, an increase of about 8 per cent in quantity and 17 per cent in value. The accompanying table shows the sales of the individual compounds.

SODIUM COMPOUNDS SOLD IN THE UNITED STATES IN 1919 AND 1920

Product	1919		1920	
	Quantity (Short Tons)	Value	Quantity (Short Tons)	Value
Sodium acetate.....	778	\$116,667	1,020	\$143,887
Sodium benzoate.....	126	230,224	201	365,841
Sodium bicarbonate.....	134,962	3,486,635	188,906	4,256,715
Sodium bichromate.....	26,526	6,233,566	25,973	5,531,954
Sodium bisulphite.....	11,819	687,750	22,059	1,028,373
Sodium bromide.....	499	493,319	543	523,724
Sodium carbonate:				
Soda ash.....	981,054	29,895,343	1,242,490	39,083,726
Monohydrate }	30,796	710,748	2,267	115,256
Trona }			10,609	343,911
Sal soda.....	80,090	2,229,994	62,857	2,128,937
Sodium chloride (common salt)				
Salt in brine.....	2,850,639	1,423,424	2,819,881	1,834,362
Rock salt.....	1,642,057	6,240,450	1,683,020	7,338,079
Evaporated salt.....	2,390,206	19,410,820	2,444,002	21,334,840
Sodium citrate, tartrate, and bi-tartrate.....	33	58,128	45	67,115
Sodium ferrocyanide.....	3,437	1,346,285	2,930	1,318,049
Sodium fluoride and acid fluoride.....	(a)	(a)	934	210,782
Sodium fluosilicate.....	(a)	(a)	719	143,800
Sodium hydroxide.....	311,388	20,091,978	382,680	25,894,641
Sodium iodide.....	12	86,985	10	29,905
Sodium nitrite.....	676	151,621	140	56,184
Sodium phosphate.....	14,760	1,733,996	30,515	3,233,896
Sodium silicate.....	300,138	5,879,628	304,503	5,751,088
Sodium cyanide, peroxide and nitrate (refined).....	17,188	5,331,123	8,633	3,415,085
Sodium sulphate:				
Salt cake.....	134,685	2,035,543	184,946	2,076,350
Glauber's salt.....	42,087	860,977	44,479	963,293
Niter cake.....	83,402	271,424	308,638	788,544
Sodium sulphide.....	45,448	2,645,181	42,952	2,962,033
Sodium sulphite.....	(b)	(b)	3,778	197,782
Sodium tetraborate.....	28,518	4,351,891	35,281	5,674,012
Sodium thiosulphate.....	32,212	1,709,223	24,868	1,283,697
Other sodium compounds	2,190	1,144,883	6,141	1,240,477
	9,165,726	\$118,857,806	9,886,020	\$139,336,338

(a) Included in other sodium compounds.

(b) Included in sodium bisulphite.

Sodium bichromate, ferrocyanide, nitrite, thiosulphate (hyposulphite) and sal soda were the only compounds that showed considerable decreases in 1920. Several of the compounds made good advances over 1919, and sodium bicarbonate, bisulphite, phosphate and borax made new records.

NATURAL SALTS

The sales of sodium compounds derived directly from natural sources in 1920, exclusive of common salt, also probably made a new record. They amounted to 41,683 tons, valued at \$1,513,179, as compared with 29,120 tons, valued at \$874,083, in 1919. The salts included under this head are sodium carbonate, sulphate, trona and borax.

The following list gives the imports of certain salts in 1920 and the changes from 1919. Compounds in which there were no significant changes in imports over 1919 are not included:

Product	Quantity (Short Tons)	Value	Increase Over 1919	
			(Short Tons)	
Sodium carbonate.....	761	\$37,844	323	
Sodium chloride.....	281	50,266	262	
Sodium cyanide.....	137,654	686,499	78,140	
Sodium ferrocyanide.....	3,795	1,091,443	1,208	
Sodium nitrate.....	1,101	400,873	452	
Sodium nitrite.....	1,480,519	63,121,035	1,024,053	
Sodium phosphate.....	5,845	1,378,992	4,570	
Sodium sulphite.....	330	15,162	131*	
Sodium sulphide.....	519	47,064	315*	
All other sodium salts.....	260	36,777	146	
	1,631,065	\$66,865,955	1,108,708	

* Decrease.

The only compounds whose imports exceed the domestic production are sodium nitrate and nitrite. Moreover, the imports of sodium nitrate vastly exceed those of any other compound.

The following table gives the exports of domestic sodium compounds for 1919 and 1920. The table does not include foreign salts re-exported, chiefly sodium nitrate and common salt. It will be seen that good increases were made

in 1920. The total is believed to be a record. Japan, Canada and Mexico were the leading consumers of our exports.

DOMESTIC SODIUM SALTS EXPORTED FROM THE UNITED STATES IN 1919 AND 1920, BY CLASSES

Product	1919		1920	
	Quantity (Short Tons)	Value	Quantity (Short Tons)	Value
Sodium bicarbonate.....	.....	.....	10,321	\$616,261
Sodium carbonate:				
Soda ash.....	50,481	\$2,656,608	8,338	4,689,591
Sal soda.....	5,563	178,285	6,015	220,487
Sodium chloride (common salt).....	119,416	1,396,625	139,278	1,901,593
Sodium hydroxide (caustic soda).....	82,118	6,748,762	112,069	10,944,007
Sodium silicate.....	12,150	338,818	17,048	450,770
Sodium tetraborate (borax).....	.....	.....	7,163	1,206,936
All other sodium salts.....	7,226,322	.....	.....	7,161,784
		\$18,545,420		\$27,191,429

PRICES

The prices obtained for sodium compounds in 1920 were generally better than those in 1919, although toward the end of the year the prices of most of the salts fell to about the levels they reached at the beginning of the year. Jobbers' prices appeared to be an accurate index of the consumers' demands. Sodium sulphate was in especial demand in 1920 on account of foreign bids, and it closed the year at a slightly higher price than in the previous year. The price of sodium bichromate was at one time higher than it was during the war, but fell abruptly later in the year.

In view of the differences that still exist in the costs of the various items that make up the costs of manufacture existing prices of sodium compounds now appear to be practically down to pre-war levels.

Circuit Court Reverses Federal Trade Commission on Gasoline Container Ruling

The United States Court of Appeals for the Second District has handed down a decision reversing the ruling of the Federal Trade Commission of April 27, 1920, which ordered the Standard Oil Co. of New York and the Texas Co. to cease furnishing gasoline containers to retail dealers at a nominal rental.

The ruling was made by the Federal Trade Commission, after taking a great deal of testimony, to the effect that both companies were engaged in the practice of supplying tanks, pumps and other devices to retail dealers for the supplying of gasoline to automobiles, for which only a nominal rental was charged. The commission found that neither company was engaged in the manufacture of such equipment, and held that such practice tended to create a monopoly, inasmuch as the retail dealer would furnish only gasoline made by the company which supplied the equipment.

The petitions of the companies for a reversal of the order were submitted to the court without argument.

The opinion of the court, which was written by Judge Hough, states that the court was unable to find there was any contract between the companies and the retailers by which the latter were restricted to the use of a certain container or from selling any brand of oil. The court held, however, that it would be unfair and dishonest for a retailer to sell the product of one company from the container supplied by another and that all that secured trade for the wholesaler was the amount of business which the retailer could secure in his community through obviously fair and honest practices.

It was possible, the court held, that where any system of distribution of an article of prime necessity and enormous consumption is well established, temptation may arise through competitive distribution to enter into treaties for regulation of price, classification of customers and division of the areas supplied, thus creating a sphere of influence—one for each of the distributing parties.

However, the court held that such a condition did not exist under the facts submitted, and from the testimony adduced at the hearing, held that the system was extremely advantageous to the company, economical and not unfair in law. The leases as made, the court held, did not constitute a violation of section 3 of the Clayton act and the ruling of the commission was ordered reversed.

Conferees Agree on Emergency Tariff Bill

With the exception of a reduction from six to three months in the time during which the War Trade Board may continue to exercise its authority over dye imports, the dye-stuffs title of the emergency tariff bill was unchanged by the conferees. The conferees agreed upon various compromises at a late hour on May 18, after a series of very acrimonious sessions. The principal differences between the conferees, however, had to do with the administrative features of the bill.

Merchants' Association of New York Urges Increase of Patent Office Salaries

In accordance with action taken by the board of directors of the Merchants' Association of New York appeal has been made to Congress to increase the personnel and compensation of the employees in the Patent Office. This appeal took the form of a letter addressed by S. C. Mead, secretary, to the members of the Committee on Patents of the House of Representatives as follows:

The Merchants' Association of New York desires to be recorded with you, as chairman of the House Committee on Patents, as in favor of the enactment of H.R. 210, a bill to increase the force and salaries in the Patent Office. As we understand it, this bill is identical with H.R. 11984 in the former Congress, which finally failed of passage.

Our committee which has jurisdiction over these matters is of the unanimous opinion that an increase in the personnel and morale of the employees in the Patent Office is necessary in order to clean up the large amount of applications awaiting the attention of the Patent Office.

In this connection we desire to be on record as in favor of the bill as it now stands and to record our opposition to the amendment which was attached to H.R. 11984 while in the Senate, this amendment providing for placing in the hands of the Federal Trade Commission jurisdiction over certain patent procedure. It is the belief of the Merchants' Association of New York that the enactment of H.R. 210 in its present form and without any such amendment as was added to the former bill is desirable.

Superpower Survey Meeting

Prior to completing its final report on June 30, the Superpower Survey held a meeting in New York on May 13 at which members of its advisory board and several guests were invited to discuss the physical, legal and financial phases of the problems under consideration. Prof. L. P. Breckenridge, chairman of the advisory board, presided. W. S. Murray, chairman of the Superpower Survey, discussed the physical features, E. G. Buckland, vice-president, New York, New Haven & Hartford Railroad, the legal aspects and W. S. Barstow, president, W. S. Barstow & Co., the financial phases. In addition to those just mentioned, the following were present: Dr. George Otis Smith, director of the United States Geological Survey, which is conducting the superpower survey; General Guy E. Tripp, chairman of the board, Westinghouse Electric & Manufacturing Co.; Thomas E. Murray, president of Thomas E. Murray, Inc., consulting engineer; H. I. Harriman, president, New England Power Co.; A. J. Sheldon, Lee Higginson & Co.; M. W. Alexander, chairman National Industrial Conference Board; C. L. Edgar, president of the Edison Electric Illuminating Co. of Boston; George Gibbs of Gibbs & Hill, consulting engineers; Colonel Charles Keller, Board of Engineers for Rivers and Harbors; Arthur D. Little, of Arthur D. Little, Inc., chemist; James H. McGraw, president McGraw-Hill Co., Inc.; J. H. Pardee, president J. G. White Management Corporation; Walter Thayer, Pennsylvania R.R.; Henry Flood, Jr., engineer-secretary Superpower Survey.

PHYSICAL ASPECTS

W. S. Murray in his summary of the physical aspects of the survey pointed out that had the facilities which he is advocating for the superpower zone been in existence during 1919 the coal savings would have amounted to 4,300,000 tons for the utilities, 9,566,000 tons for the railroads and 11,000,000 tons for the industries, or a grand total of 24,866,000 tons. If the generation of power continues unco-

ordinated, he contended, the annual coal waste will be 50,000,000 tons by 1930, which at \$5.35 a ton would represent a monetary loss of \$266,500,000. Mr. Murray estimated that the project would require \$100,000,000 each year for the next ten years.

DISCUSSION

In answer to E. G. Buckland, who asked how much less than \$100,000,000 per year would be required by the separate utilities to take care of increasing business without the superpower company, W. S. Murray said that more money would be required for construction by individual companies than would be necessary for the superpower system.

Mr. Edgar agreed with Mr. Murray that there was nothing in the superpower proposition that has not already been done. What has already been done over 600 miles will be applied to over 30,000 miles. The educational value of Mr. Murray's report should be great, he said.

The legal and financial phases were also discussed at length. Several important legal difficulties which would have to be overcome were cited by H. I. Harriman in the development of his argument that the superpower company should be organized under a federal charter rather than under a charter granted by any state. He indicated several obstacles to interstate business embodied in laws of several of the New England States. These obstacles he thought could be overcome more readily under a federal charter. On the other hand, Dr. George Otis Smith said that the project should not be owned or operated by the Government and called attention to the conservation by the project of financial as well as physical resources.

Regarding the educational value of the project James H. McGraw said that the superpower plan should appeal to the "man in the street" because the results can be demonstrated. Prof. Breckenridge pointed out that the wage earner in this country uses two and a half to three and a half times as much power as the wage earner in Europe—another strong appeal to "the man in the street."

To Urge Continuance of Muscle Shoals Dam

An investigation of the whole Muscle Shoals proposition has been made by a committee of the Farm Bureau Federation. This is the principal organization of farmers represented in Washington. The committee is now preparing its report and declines to comment on it in advance of its completion, but it is understood that it will urge strongly the resumption of work on the Wilson dam at Muscle Shoals at the earliest practicable moment.

Representative Graham, who as the head of the committee which investigated war expenditures evinced particular enmity to the Muscle Shoals project, has introduced a bill authorizing the Secretary of War to lease the dam and Nitrate Plant No. 2. The Farm Bureau committee is said to be opposed to any such plan because of the difficulty likely to arise in arranging for the manufacture of cyanamide by other than the Government. Other objections are that Congress would demand such safeguards in connection with a lease as to make it impracticable from the commercial standpoint. The Graham bill provides that the Secretary of War may lease Plant No. 2 for a period not to exceed twenty years to any co-operative agricultural association or corporation. The lease is to include the steam power plant and may be extended so as to empower the lessee to complete the dam. The bill provides that the lessee must provide a bond to guarantee the maintenance of the plant in good condition. It is to be surrendered to the United States at any time on the demand of the President when it may be required for military purposes. The bill further specifies that the plant must be maintained as an air nitrate operation.

Chemical Warfare Service Appropriation

The appropriation for the Chemical Warfare Service for the next fiscal year is \$1,350,000 in the Army bill as passed by the House. An effort will be made to increase the amount in the Senate. This is one-sixth of the amount originally requested by General Fries and less than one-third of the amount declared by the Secretary of War to be necessary to the proper conduct of that service.

Physical Methods for the Chemist

Optical methods as servants of the chemist were discussed in a symposium at the Chemical Society of Washington on May 12. At this time five speakers developed various phases of optical measurement or investigation which afford large promise in both the routine and the research branches of pure and applied chemistry.

QUANTITATIVE SPECTRUM ANALYSIS

"Quantitative Spectrum Analysis" was the title of the first paper, which was by W. F. Meggers, of the Bureau of Standards. This speaker pointed out that following the elementary use of the platinum wire and bunsen burner for identification of materials by the color of the flame most chemists fail to utilize spectrum analysis further in their scientific work. It has quantitative as well as qualitative possibilities in chemical as well as in stellar analysis, and with the proper recognition of modern methods is applicable to a number of particularly difficult analytical problems.

SPECTRO-PHOTOMETRIC METHODS

W. E. Mathewson, of the Bureau of Chemistry, discussed the application of spectro-photometric methods to the estimation of colorless substances. Using a suitable spectrophotometer the accuracy depends upon the matching of the brightness of two fields. With ordinary light this matching cannot be accurately done because the percentage change in transmission of white light is not of sufficient magnitude in most cases. However, using monochromatic light or observing the transmission of certain parts of the spectrum a much greater percentage variation of the transmission can be noted with a given change in concentration. Dr. Mathewson applies this method to solutions of colorless materials after treatment of the material to be identified so that it is converted into a colored substance or dyestuff.

DIRECT-READING SPECTRO-PHOTOMETER

I. G. Priest described the form of direct-reading spectrophotometer for measuring the transmissivity of liquids which he has developed at the Bureau of Standards. A beam of monochromatic light is divided into two parts, one of which passes directly to the observing telescope through a sectored disk of variable transmission. It is compared by photometric methods with the second part of the beam which passes through the solution to be tested. The distance between the inlet and outlet prisms which conduct the light into and out of the solution may be varied. An equal brightness of the two beams can be established either by adjusting the opening in the sectored disk or by varying the distance between the prisms—that is, varying the distance within the solution through which observation is being made. The instrument reads directly in terms of the extinction coefficient or the percentage transmission, as well as in terms of depth of liquid and percentage transmission of the disk.

The apparatus is applicable to colorimetric investigation of vegetable oils, dyestuffs, sugar solutions and other colored liquids. Moreover, the results give a scientific definition of color independent of the characteristics of the illumination or the personal defects of vision of the observer.

POLARIMETRY

F. J. Bates, chief of the sugar laboratories of the Bureau of Standards, discussed the possibilities and applications of polariscope methods in chemical investigations. He pointed out that for many years an error in the standards of about one-tenth per cent was the cause of many unexplained discrepancies in this work. However, this cause of difficulty has now been eliminated and it is possible to do polariscope work with apparatus good to one one-thousandth circular degree and with apparatus of variable sensitivity suitable for a wide variety of materials.

Tool's application of the Brace half-shade principle permits further work on double refraction of materials under strain and measurement of different phenomena. This combined with determinations of magnetic rotation affords possibilities for the identification of oils. For example, a

single observation is often sufficient to show whether a fuel oil or gas oil is a straight-run product or has been partly cracked. Obviously the straight-run oil is vastly more satisfactory for gas making or gasoline manufacture than an oil which has already been partly cracked. Therefore this difference is of very great importance. Similar applications in other fields are expected by Dr. Bates.

CRYSTAL OPTICS

F. E. Wright, of the Geophysical Laboratory, discussed the application of crystal optics in chemistry. He pointed out that the methods used in this field are of much greater complexity from a practical standpoint than in the other fields discussed. Long and continued experience in the use of these methods is of greater importance than in the other cases, and it is obvious, therefore, that the chemist cannot expect to get as much in this province of optics as in the others.

University of Chicago Reports Favorably on Plan for Scientific Research

Wallace Heckman, counsel and business manager of the University of Chicago, in his annual report favors the plan for promotion of scientific research as outlined by William Hoskins and Russell Wiles in CHEMICAL & METALLURGICAL ENGINEERING, issue of April 20, 1921, page 689. The text of his announcement is as follows:

"Men engaged in research in our scientific laboratories frequently obtain results of importance which, if accomplished in commercial laboratories, would be gratifyingly valuable in financial returns.

"It is well known that the reports, addresses and talks of advanced scientific men are closely attended to by those who are acquainted with the value of what is being done and discovered, and these discoveries are actually patented and realized upon by those having no relation to the work and not entitled to those returns.

"This laboratory work is conducted upon high ethical principles, and the individuals conducting these researches disdain to derive the personal benefits from them which the law would justify. If, to the results of this work educationally and scientifically, its financial value can, without injury to these other values, be conserved, it would place the institution in possession of additional and legitimate resources.

"The advantage of such a course to these laboratories would seem to be obvious. These legitimate returns might reasonably be expected ultimately to provide the amplest equipment and provisions for these departments."

It is interesting to note that the text of the article mentioned above was submitted by Mr. Hoskins to the university many months ago and the official notice of the favorable action of the university was not made public until May 9, 1921.

Weights and Measures Conference

The fourteenth annual conference on weights and measures is in session (May 23-26) at the Bureau of Standards in Washington. Pending legislation looking to the adoption of the metric system of weights and measures is to be one of the subjects discussed at this conference. Other matters which will be taken up include: The slack-filled package bill; proper sealing of commercial weighing and measuring apparatus; the weight problem in interstate commerce; enforcement of bread weight legislation; testing of liquid-measuring devices; standardization of containers for food; net weight-marking on packages of commodities other than foods.

Chemical Exhibition at Wilmington

During the week of May 10 the National Research Council, Washington, D.C., held an interesting and instructive chemical exhibit in the lobby of the Hotel du Pont, Wilmington, Del., under the direction of Major H. S. Kimberly. The exhibition covered the work of the Chemical Warfare Service, and was brought to the city through the efforts of the local Chamber of Commerce. A complete model of an American dye manufacturing plant was also shown.

Supreme Court Ruling on Mixed Acid

The Supreme Court of the United States in an opinion May 16 in the case of the United States vs. the Aetna Explosives Co. ruled that "The applicable tariff act granted free entry to both nitric and sulphuric acids and viewed practically the commodity in question was nothing more than nitric acid rendered non-injurious to steel tanks by adding sulphuric acid of small value. The two acids do not interact and the result was a mere mechanical mixture not intended or adapted as such for commercial use and not a chemical mixture," within the true intent of the statute. The case arose from the importation of nitric acid by the Aetna Explosives Co. from Canada during the war. The acid, intended for use in the manufacture of explosives for the Navy, was mixed with sulphuric acid in order that it might be shipped in compliance with the law. Customs officials ruled that this mixture formed a new compound which was dutiable.

Improved Conditions in Leather Industry

Recovery from the abnormal conditions which existed in the leather industry during 1920 is indicated in the following statement by Vice-President Julius Hollander, of the Amalgamated Leather Co.:

"The leather business looks very promising. It is bound to increase as the season progresses and I sincerely believe that we are going into quite an active season. Stocks of raw skins in this country are very small. The situation is righting itself very materially. In our business we are getting hurry calls right along for kid. Buyers are purchasing today from necessity because of depleted stocks. This makes for a fundamentally sound condition. In 1919 if a man needed only 1,000 dozen skins he would buy perhaps 2,000 dozen. Today the situation is reversed. There is no disposition to load up."

Electric Heating Exhibit

During the week of June 6 practically all of the electrical appliances for industrial and domestic heating that have been perfected within the past five or ten years will be exhibited at the showrooms of the New York Edison Co., Irving Pl. and 15th St., New York. Forty-one manufacturers will be represented and at least one hundred different applications of electric heat will be shown. These include self-contained units for localized heating capable of producing very high temperatures, tubular heaters for oil, paraffine and other flammable liquids where an exposed flame is dangerous and a wide range of industrial heating equipment.

No admission fee will be charged and the show will be open every day from 9 a.m. to 6 p.m.

Many New Chemical Companies Formed

During the first four months of the present year new chemical companies with an aggregate capital of \$49,900,000 were organized and incorporated in the United States, as compared with a total capitalization of \$64,863,000 for similar industries in the same period of 1920. In March thirty-two companies with individual capitalization of \$50,000 and over were formed, with an aggregate capital of \$11,765,000. In April twenty-eight such companies were organized, with a total aggregate capitalization of \$9,390,000. In April, 1920, the companies in this line which were formed had a total capital of \$4,675,000.

Reprint of Nitrogen Report Asked

A resolution has been introduced in the Senate asking that a reprint be made of the report of the Secretary of Agriculture concerning ammonia, nitrogen and nitrogenous materials manufactured, imported and used in the United States. The report was sent to the Senate April 8, 1918.

No Chance for National Daylight Saving

It has been decided definitely by the committees of Congress having jurisdiction over daylight saving bills that the subject is not to be given consideration. This puts an end to the hope that daylight saving might again be made national during the coming summer.

Chemical Exhibit Draws Crowd

When the National Research Council obtained permission to display its chemical exhibit in the caucus room of the House Office Building a precedent was established in that this is the first time that an exhibit of this character has been staged in the halls of Congress on Capitol Hill. The exhibit was on display throughout the week beginning May 16. Since Capitol Hill is the mecca of every tourist and most business visitors to Washington, an opportunity was given to enlighten a large number of persons as to the relationship between the chemical industry and the national defense.

The exhibit was made realistic and attractive by models showing how the crude materials were carried through their various processes. Special effort was made to emphasize the fact that the primary processes are the same whether the products are to be those of peace or those of war.

An interesting part of the exhibit was the display of American-made dyes, flavoring extracts, coloring extracts, perfumes and coal-tar products. There were cleverly executed charts bringing out some of the salient facts concerning the relationship of chemistry and the national defense. The Chemical Warfare Service also displayed one of its exhibits. Judging from the expressions of visitors it was clear that the exhibit was successful in that it demonstrated that the wizardry of the chemist is essential for industry as well as for war.

Personal

T. E. BARKER, for fourteen years production manager of the Miehle Printing Press Co., Chicago, has resigned to accept a post with the Denver Rock Drill & Manufacturing Co. Mr. Barker has been prominently identified with the early development of the American Society for Steel Treating, serving as first chairman of the Chicago Section of the Steel Treating Research Society, two years as national president of the American Steel Treaters Society, and is now acting as first vice-president of the American Society for Steel Treating.

W. F. CARMAN of the China Chemical Co., New York, has returned from a business trip to Europe.

CHESTER M. CLARK, formerly head of the corporation department of Stone & Webster and secretary of the underlying corporation of Hog Island, has become treasurer of Arthur D. Little, Inc., in the place of W. W. Caswell.

SIDNEY COHN, president of the Pacific Chemical Co., New York, sailed on the Mauretania, May 12, for a four months' business trip in England, France and Germany.

BENJAMIN S. DOWELL of the du Pont Chemical Co., Elkins, W. Va., has been appointed secretary of the local Chamber of Commerce.

J. A. GERBER has resigned as manager of the chemical department of the Caravel Co., New York, to organize the Federal Chemical Co., Nitro, W. Va., of which he will act as head.

ANDREW H. GREEN, JR., formerly manager of the Detroit plant and also vice-president in charge of the Detroit works of the Solvay Process Co., was recently placed in complete charge of all technical and operating departments of the company, with headquarters at Syracuse, N. Y.

DONALD M. NELSON, who has worked up through the chemical organization of Sears, Roebuck & Co., has recently been made manager of the clothing department for this concern. Mr. Nelson is looked upon by the chemical profession of Chicago as being one of the best informed men in the textile industry.

T. A. PATTERSON has resigned his position as assistant superintendent of the Niagara Alkali Co., Niagara Falls, N. Y., to accept a position as superintendent of the Belle Alkali Co., Belle, W. Va.

Dr. FREDERICK BELDING POWER, in charge of the phytochemical laboratory of the U. S. Department of Agriculture,

has been presented a gold medal by Henry S. Wellcome, of London, in recognition and appreciation of distinguished services to science as director of the Wellcome Chemical Research Laboratories. Dr. Power has been with the federal government at Washington for several years, but was in London for more than eighteen years engaged in the work for which he has been thus honored.

HUGO SCHLATTER of Wilmington, Del., who for several years has been manager of the Chemical Products Division of the Hercules Powder Co., has resigned his position and is planning a trip to Europe in June. While abroad Mr. Schlatter will visit a number of manufacturing plants and will make special investigations and reports for firms in the United States which have taken advantage of the opportunity to have him execute technical commissions for them.

MARTIN R. SUMNER, formerly chief engineer for New England for Fred T. Ley & Co., and of the staff of the Fuller Development Co., has joined the staff of Arthur D. Little, Inc., as chief engineer.

YORK University, the University of California and Brown University. He was married on April 11, 1893, to Miss Anne Wintermute, of Tacoma, Wash., who survives him with their two children—Mrs. Nancy Lane Kauffman, of Washington, and Lieutenant Franklin K. Lane, U. S. A., of Los Angeles, Cal.

JOHN MCQUADE, president of John McQuade & Co., Brooklyn, N. Y., manufacturer of paint, died recently at his home in that city.

CHARLES HOSMER MORSE, founder and chairman of the board of directors of Fairbanks, Morse & Co., died May 5 at his home in Winter Park, Fla., after an illness of several weeks' duration. Mr. Morse was a pioneer in the field of oil engine development, having worked with the inventor of the gasoline engine, James A. Charter, in the early '90s and subsequently developed considerable apparatus in the electrical and railway appliance fields. He is survived by his wife, Helen H. Morse, and two sons, Charles Hosmer and Robert Hosmer, both of whom have been associated with him in business for many years.

Dr. EDWARD BENNETT ROSA, chief physicist of the Bureau of Standards, died suddenly at his desk on May 17. Dr. Rosa was born in Rogersville, N. Y., in 1861 and was graduated from Wesleyan University, Middletown, Conn., in 1886. Five years later he received his doctor's degree from Johns Hopkins University. He returned to Wesleyan as a professor of physics, where he invented a number of measuring instruments, besides conducting important investigations in dielectric measurements, alternating-current wave forms, electromagnetic units, etc. In 1901 he joined the Bureau of Standards as a physicist. Much of the work which was done under his direction at the bureau is of fundamental importance to electrochemical as well as electrophysical investigations. These researches include studies of dry cells and storage batteries, the basic work on the mercury ohms, standard cell investigations of international significance, and the finest work on the silver voltameter which has ever been done. Dr. Rosa had an exceptional appreciation of the value of chemistry and the chemist in physical research, and was most successful in combining physics and chemistry for fundamental work that neither science alone could accomplish. He was a fellow of the American Institute of Electrical Engineers, a former director of the Illuminating Engineering Society and was one of the most active members of the American Engineering Standards Committee. Dr. Rosa had been a member of the International Electrical Commission, was honorary secretary of the International Electrical Congress held in San Francisco in 1914, and in 1913 was elected to the council of the French Physical Society.

ADOLPH SORGE, JR., well known in engineering circles in Chicago, died May 5. Mr. Sorge was a graduate of the Stevens Institute of Technology of the class of 1875. After leaving school he went with the E. W. Bliss Co., Brooklyn, N. Y., and in 1893 he became general manager of the Wood-Mosaic Co. of Rochester, N. Y. While in Rochester he acted as adviser to Selden in framing the claims of the famous automobile patent subsequently issued to the latter. In 1895 he became general Western representative of the Harrison Safety Boiler Works of Philadelphia, subsequently incorporated as the H. S. B. W.-Cochrane Corporation. He was the first to see the advantages of heat in the chemical treatment of water for the removal of hardness, and the present Sorge-Cochrane hot process water softener is a further development of ideas originally patented by him. He was often consulted on steam plant problems and his skill in rectifying defective steam plant piping was widely known throughout the West. He was one of the originators and founders of the Technical Club of Chicago and was also a member of the Engineers clubs of Chicago and New York, as well as of the American Society of Mechanical Engineers. His command of concise, perspicuous English was exceptional and he also spoke French and German fluently, enjoying an extensive acquaintanceship among European engineers. His home was in St. Joseph, Mich., where he gratified his love for country life and things agricultural. His wife survives him.

Obituary

GEORGE J. FORAN, engineer, art collector and member of the committees on condensing apparatus of the U. S. Shipping Board and the War Industries Board during the war, died recently at his home in New York City, after an illness of several weeks. Mr. Foran was manager of the condenser department of the Worthington Pump & Machinery Corporation and the associated companies of the International Steam Pump Co. from 1901 until his death. He was born in Boston, Mass., Jan. 22, 1862.

FRANKLIN KNIGHT LANE, Secretary of the Interior in President Wilson's Cabinet, died at Rochester, Minn., May 18. Mr. Lane was born near Charlottetown, Prince Edward Island, on July 15, 1864. In his childhood the family removed to California and he was educated at the University of California, class of 1886. He then engaged in newspaper work, came to New York for a time as the correspondent of various Western papers and later became editor and part owner of the Tacoma (Wash.) *Daily News*. Having been admitted to the California bar in 1889, he engaged in legal practice and began to give some attention to politics. His first public office was that of corporation counsel of San Francisco, which he filled from 1897 to 1902. In 1905 President Roosevelt appointed him a member of the Interstate Commerce Commission, in which place he remained for eight years. He won the reputation of being a constructive statesman of broad principles and progressive ideas and attracted the favorable attention of men of all parties throughout the nation. Indeed, his repute became international, for in 1910 he was elected a member of the permanent International Railway Commission which was organized at the International Railway Conference at Berne, Switzerland. Mr. Lane was made Secretary of the Interior in the first Cabinet of President Wilson in 1913. During America's participation in the World War, Secretary Lane was a member of the Council of National Defense and was active in Red Cross affairs and was chairman of the National Industrial Conference which was convened because of conditions created by the war. As chairman of the Railroad Wage Commission in 1918 he was chiefly to be credited with averting a number of strikes and settling numerous disputes. At the end of the war he was energetic and farsighted in plans for the restoration of normal conditions. He devised methods for the profitable employment of the returning troops, advocating legislation which would settle upon agricultural lands all soldiers who wished them, and urged Congressional legislation for the complete naturalization of all foreign-born soldiers. On Feb. 7, 1920, he sent to the President his resignation, to take effect on March 1 following. The reason which he gave for this action was the necessity that he should "think of other duties." Mr. Lane received the honorary degree of LL.D. from New

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, May 23, 1921.

The general condition of the chemical market during the past week has been somewhat similar to that noted recently. There is a marked gradual increase in confidence all around and outside developments seem to be working favorably toward establishing the market on a stable basis. Although buyers have not come into the market to any appreciable extent, the influx of miscellaneous inquiries is growing larger and there is no doubt that consumers are taking a greater interest in market developments than for some time past. There have been several large inquiries on the market from Japan, and while these have not resulted in the actual consummation of important business it is very significant that conditions are improving in the East. It looks as if the Orient will be a large buyer before the year is over. The passage of the emergency tariff bill by the Congress will regulate the prices at which foreign sellers can compete with domestic commodities. *Nitrite of soda* responded immediately to the prospects of the tariff law becoming effective in the very near future.

READJUSTMENT OF FREIGHT RATES NEEDED

One of the most unfavorable features confronting the chemical producers at the present time is the railroad freight situation with its abnormally high rates. A reduction in rates would no doubt have a stimulating influence on many branches of industry throughout the country. With a prompt reduction in freight rates a readjustment of prices will likely take place on the more important basic chemicals. The signing of the reparations agreement with the German Government is an important factor toward speeding up reconstruction work, which is practically depending on the industrial world. A general reduction in labor costs is spreading in various parts of the country without any noticeable disarrangement. In summarizing, it is apparent that freights are going to be lowered. Costs are being regulated more closely and the foreign situation has shown signs of a gradual improvement. It seems almost certain that a credit system will be established with Europe to permit the purchase of raw materials. All these features show that the intense problems facing business are being slowly solved and the drift of events is decidedly encouraging to the restoration of better times.

CITRIC AND TARTARIC ACID PRICES DECLINE

Among some of the price changes during the week was a decline in *citric acid* prices on spot and a similar decline in imported *tartaric acid* quotations. The absence of any demand has brought on a keener state of competition among holders and price shading was inaugurated with the idea of increasing business. Makers of *acetone* reduced prices more in line with the cost of production. *Yellow prussiate of soda* held its recent advance well, under small lot trading. *Nitrite of soda* was one of the strongest items on the list and the position of the market appears much stronger through prospective tariff legislation. Solid *caustic soda* and light *soda ash* have remained very steady with producers placing fair sales for domestic use in soap, textile and glass industries.

CHEMICALS

Strength in the spot market on *bichromate of soda* was a feature and a good call was reported for small lots from the consuming trade. Resale offerings are relatively small and sellers are asking 8@8½c. per lb. for standard brands with sales reported at the inside figure. Some resale domestic *caustic potash*, 88-92 per cent, was offered at 5½c. per lb. on spot. There are sellers of the imported at 6c. and upward depending upon quantity. Producers'

views are unchanged on this grade and 12c. per lb. was being quoted f.o.b. works. Manufacturers report sales of *chlorate of soda* at 7½c. per lb. works for prompt shipment. A moderate inquiry is reported for domestic consumption. Sales of *nitrite of soda* were made during the week as high as 7½c. per lb., with some sellers asking all the way up to 8½c. Some holders have withdrawn their offerings from the market, as they are firm in the belief that higher prices will soon be recorded. Buyers are showing considerably more interest in the situation and there is a very confident feeling in trade circles. Dealers in foreign *prussiate of soda* report a firm spot market and state that business is going through in small lots at 12½@13c. per lb. Offerings are not heavy and there seems to be a disposition to tighten up in some quarters. Resale offerings of light *soda ash* are gradually decreasing and the spot market shows an extremely firm tendency. Most dealers are not willing to shade \$2.10 per 100 lb. on single bags and some are asking above this figure. The best price heard on ash in barrels was 2½c. per lb., while 2½c. was asked in several directions for limited quantities. Dealers in *bleaching powder* report additional sales on a basis of 2½c. per lb. f.o.b. works in large drums. Spot material is held at 2½c. and upward according to quantity. Resale lots of *sulphide of soda*, 60-62 per cent, fused, were offered at 5½c. per lb. spot N. Y. There is a pronounced scarcity of resale offerings of ground sulphide and the market is quoted firm. *Yellow prussiate of potash* continues in relatively limited supply and the market is quoted steady at prices ranging from 26@28c. per lb. Demand has not been markedly active for this chemical, but buyers have found a stiff proposition when they attempted to operate. Trading in *formaldehyde* is reported at 14½c. per lb. on spot in barrels. The price range extends upward to 15c. depending upon quantity and seller. Small lots continue to merit the most attention, but there seems to be an absence of round lot transactions.

COAL-TAR PRODUCTS

A gradual improvement in the various industries which directly affect the coal-tar products market is commencing to be reflected in different quarters of the trade by inquiries and orders for items that have long been dormant. Silk piece goods business is picking up and the woolen market is rapidly gaining strength. Along the line of colors and dyestuffs, the reports of manufacturers find the demand spreading. A good call from foreign sources has started and an immediate improvement in this field is expected to continue along steady lines. With the emergency tariff bill and protection against dumping practically assured, the general tone of the market is far more optimistic than at any previous time this year.

The intermediate market is decidedly firmer and calls have been received recently for some inactive items. Factors in home quarters report a regular supply of *alpha naphthylamine*. The volume of inquiries is light and very little business is said to be passing. Prices have shown very little change from the former level and range from 35@40c. per lb. The market for *anthracene* is of a routine nature, with a limited supply moving into consuming channels. There has been no change in the market price, which ranges from 85c.@\$1 per lb. for the 80 per cent grade. The consuming demand for *phthalic anhydride* continues along routine lines and the same may be said of the crude. Supplies are easy with quotations ranging from 50@60c. per lb. Business in most quarters on *alpha naphthol* is reported as dull. Producers have made no recent change in prices, which are quoted on a basis of \$1.10@\$1.15 per lb. for the crude and \$1.25@\$1.30 for the refined material. Trading in the market for *dinitrotoluene* is limited to small lots. Supplies are of a fair volume and range in price from 25@27c. per lb. The market on *ortho-nitro-phenol* reflects a firm tone and a steady demand for supplies is heard in some directions. Available supplies are rather light and quotations range from 80@85c. per lb. Some factors report the consuming demand for *para-toluidine* of small volume. Prices are quatably unchanged at \$1.25@\$1.40 per lb. Consumers seem to be fairly well supplied with *aniline oil* for the time being and only small lots are in request at irregular intervals. Supplies are easy and while some holders

are steady in their views at 20@26c. per lb. shading is possible on a firm order.

VEGETABLE OILS

Offerings of spot *chinawood oil* were scanty and holders in some directions were asking up to 14c. per lb. on small lots. May-June-July shipments from the East were offered on the basis of 10c. per lb. c.i.f. N. Y. No sales of round lots of *coconut oil* were reported. The Coast market for *Manila oil* closed at 8c. per lb. bid and 8½c. asked. sellers' tanks May-June shipment. For June-July contracts it was reported that 8c. could have been done on a firm bid. *Ceylon grade oil* on the spot was firm at 10½c. per lb. asked. It has just come to light that a prominent soapmaker has purchased 1,000 tons of *palm oil* for shipment from either Liverpool or Africa at purchaser's option. It was intimated that the market was shaded considerably for this deal. Several crushers of *linseed oil* moved the prices up to 7½c. per gal. carlot basis. Shrewd buyers, however, could have still purchased May-June shipment at 70c. per gal. Foreign cables on linseed oil were higher, with the Dutch product advanced to 68c. per gal. c.i.f. N. Y., duty paid, May-June shipment from Rotterdam. English oil was offered at £39 per ton, prompt shipment, cooperage included.

WAXES

The market on *beeswax* was fairly steady, demand being rather quiet. African crude was generally held at 16@17c. per lb., but an occasional odd lot appeared on the market at a concession. Brazilian crude was held at 24@26c. per lb. Pure white, refined, was quoted at 40@45c. per lb. according to brand and quantity. Importations of *carnauba wax* during the past week amounted to several hundred bags. The market was irregular, offerings of spot goods having increased of late. Most of the business noted was among dealers. The No. 2 North Country was quoted on a basis of 28@30c. per lb. No. 3 North Country was held at 16@17c. per lb. Offerings of *Japan wax* for spot delivery were noted at 18@18½c. per lb. This really is the normal quotation. On forward shipments 15c. per lb. was quoted with the market barely steady. Competition in *paraffine wax* for the business pending, which was not of any large volume, resulted in further unsettlement in prices. Scale wax, 122-124 deg. melting point, was offered at 2½c. per lb., carlot basis, with the 124-126 material available at 2½c. Match wax could have been bought at 3½c. per lb. Refined wax of 120-122 deg. melting point was offered as low as 3½c. per lb., with the 135-137 deg. melting point held at 5½c. per lb.

The Chicago Market

CHICAGO, May 20, 1921.

Nothing of importance developed in the industrial chemical markets during the past two weeks. So far as the consuming trade was concerned purchasing, as for some time past, was confined to small quantities for early consumption and there were no important transactions reported among dealers. With supplies of many products liberal competition among sellers is keen; however, there were few changes reported in prices.

GENERAL CHEMICALS

The *caustic soda* situation lacked new features, the market being steady, with the inquiry limited to small quantities. The ground 76 per cent continued to be quoted at \$4.75@\$4.95 per 100 lb. and the solid at \$4.10 in 1-ton lots. *Soda ash* is firm and is moving in a fair way at 2½c. per lb. *Salt soda* is also moving in a small way at 2½c. per lb. There is a somewhat better inquiry for *aluminum sulphate*, iron free, and the price is steady at 3c. per lb. *Ammonium chloride*, white gran., is lower, single casks being offered at 8½c. There is little or no demand for *ammonium carbonate* and ample supplies are available at 11c. per lb. *Ammonium sulphate* is quiet and steady at 3½c. per lb. for ton lots. The inquiry for *formaldehyde* has dropped off somewhat and the principal dealers have reduced their prices to 15c. per lb. for barrels. *Caustic potash* is in an unsteady position and it is possible to obtain prices of a wide variation. The

88-92 per cent material is offered freely at 7½c. per lb. and it is quite possible that a lower figure could be obtained with firm business. *Potassium bichromate* is very quiet, with supplies available at 14½@15½c. per lb. *Sodium bichromate* is in the same position and small quantities are offered at 8½c. per lb. Offers of *sodium nitrite* were heard as low as 7½c. for spot goods, but few sales were reported. There is a fair movement of *sodium bicarbonate* and dealers are maintaining their prices at 21@22c. per lb. *Glycerine*, c.p., is in poor demand at 16½c. per lb. and no large sales were noted. The present low price on this material should prove attractive, as it is hardly possible for it to go much lower.

The list of acids is unchanged as to prices and a better inquiry is reported from some quarters. Lower prices are predicted by some factors on *acetic acid*, 28 per cent. This article is now quoted at 23@3c. per lb. in barrels and the inquiry from the photographic trade is reported to be good. There is a better demand for *citric acid*, but no sales of consequence were noted and the price is unchanged at 47@48c. per lb. Requests for *sulphuric acid* were more numerous and manufacturers continue to quote \$19@\$20 per ton in tank cars f.o.b. works.

NAVAL STORES

The naval stores market has fluctuated considerably during the past two weeks and as yet shows no signs of steadiness. *Turpentine* is quoted today at 67½c. per gal. in drums and is said to be moving in a very fair way. Prices on *rosins* are very unsettled and some factors are asking as high as \$9.60 per 280 lb. for the WG grade.

COAL-TAR PRODUCTS

There is little or nothing doing in the coal-tar products branch of the trade and prices are unchanged. *Benzene* is quoted at 3½c. per gal., ex-warehouse, for the 100 per cent and *toluene* is offered at the same rate. A few sales of *naphthalene flakes* were noted and the price is steady at 8½c. per lb.

The Iron and Steel Market

PITTSBURGH, May 20, 1921.

The steel trade now feels convinced that there will be no material improvement in the market in the near future, which means that there is no prospect of improvement before August, since July could not be expected to develop favorable conditions.

If demand does not improve, production of steel instead of remaining stationary will decrease, as bookings in the past week or two have not been equal to shipments. The rate of steel production in the past week has been barely 30 per cent of capacity, against an average of about 31 per cent in April, and a 25 per cent rate is not unlikely to be seen before increases begin.

On account of having a regular clientèle with a large tonnage of unfilled contracts the United States Steel Corporation continues able to operate at a better rate than the independents, its percentage rate of operating, relative to capacity, being nearly double that of the independents. This is a partial offset to the lower prices the Steel Corporation accepted in 1920 as compared with the independents.

Buyers are making commitments for only very small lots, whether their commitments are in specifications against contracts, as is the case with most of the Steel Corporation business, or is in new orders, as is the case with the bulk of the current bookings of independents. Carload business is practically the rule, while orders for more than 100 tons are exceptional. Immediate shipment is usually required, which makes it that speed in delivery frequently determines where an order will go.

PRICES MAINTAINED

There are only very occasional reports of price concessions being made in finished steel products, showing that market prices are really very well maintained. In an active market concessions are not unknown, in the case of particularly desirable orders, and pass unnoticed, while in a dull market any concession is widely discussed. The

market exhibits no great degree of strength in adhering to regular prices, since incentive for cutting prices is very largely lacking, individual orders being too small to make price cutting worth while.

Of all the finished steel products, tin plate attracts the most attention on account of presenting a dull market, because tin plate has been in fairly good demand every year, not feeling industrial depressions like steel products that figure largely in construction work. Until 1919 the production of tin plate never fell in any year more than 16 per cent below the previous high record, but 1921 is now certain to show a spectacular decline. At this time in the year demand for the shipment of tin plate has always been very active, but now the tin mills are not operating at more than about 30 per cent of capacity and there are large stocks at mills, not moving to any extent. Some of the stock is tin plate made up against orders of consumers, the consumers not being willing to accept delivery as yet. For production tin plate the regular price of \$6.25 is maintained, but odd lots out of stock can be had at \$6 or less.

The pipe mills present the appearance of being decidedly busier than other departments of the finished steel trade, the average of operations being above 50 per cent, but the condition is largely explained in the fact that pipe-making capacity has increased less in the past few years than steel capacity in general.

READJUSTMENT PROCEEDING

For some time past the steel trade has been convinced that the chief deterrent to business activity has been the labor situation, both the failure of wages in many lines of activity to decline to a safe level and the unwillingness of workmen in the building trades to give a fair day's service. Building activity is regarded as impossible in the circumstances. Accordingly the steel trade has been particularly pleased by the announcement of the Railroad Labor Board this week that a reduction in wages of railroad labor is justified by conditions. The steel trade had felt that a reduction in railroad wages would be helpful in three respects: It would eventually give the railroads some spare money out of their receipts, it would improve railroad credit and it would have a favorable sentimental influence upon workmen in other lines whose wages should be reduced to put industry on a safe basis.

PIG IRON AND COKE

The pig iron market continues dull and listless. The local market remains at \$24 for bessemer, \$22 for basic and \$23.50 for foundry f.o.b. valley furnaces, with \$1.96 freight to Pittsburgh.

As nearly all the merchant furnaces are out of blast, the pig iron now being offered in the market is chiefly iron from producers' stocks, and prices are far below the actual production cost of such iron. The coke market has declined and while 1921 season prices for ore have not been developed it is established that there will be a heavy reduction from the 1920 schedule. Wages at blast furnaces have been reduced. Counting instead of the actual cost of the pig iron now offered its replacement cost, it is a question whether the iron is offered below cost. The actual experience of a valley furnace interest shows that in 1913 the total freight cost of assembling the raw materials necessary to make a ton of pig iron was \$5.33, while the cost after the rate advance of Aug. 26, 1920, was \$9.82. This is actual furnace experience, and there was a reduction in the quantity of coke consumed, so that if the 1920 quantity of coke were taken for 1913 the assembling cost would have been 25c. less. Thus the increase caused by freight rate advances on the cost of producing a ton of pig iron is \$4.74. This does not take account of the charge now imposed for slag wasting, necessary for most furnaces, so that the total increase may be set conservatively at \$5 for a valley furnace. For several years before the war the lowest market price of basic pig iron at valley furnaces was \$12.25. To get an equally low price under present conditions \$5 should be added for freights and allowances made for higher wage rates in coke making, limestone quarrying, ore mining and furnace operation. Connellsville coke is now \$3.25.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride	lb. \$0.12	\$0.40 - \$0.45
Acetone	lb. 2.50	2.75 - 3.00
Acid, acetic, 28 per cent	100 lbs. 4.00	4.25 - 4.50
Acetic, 56 per cent	100 lbs. 4.00	4.50 - 5.50
Acetic, glacial, 99½ per cent, carboys	100 lbs. 9.75 - 10.00	10.25 - 10.50
Boric, crystals	lb. 13½	14½ - 15
Boric, powder	lb. 15	15½ - 16
Citric	lb. 1.50	1.65 - 1.75
Hydrochloric, 52 per cent	lb. 13	13 - 14
Lactic, 44 per cent tech	lb. 10	11 - 11½
Lactic, 22 per cent tech	lb. 0.41	0.51 - 0.6
Molybdate, C. P.	lb. 4.00	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric)	lb. 0.6	0.7 - 0.7
Nitric, 40 deg.	lb. 0.7	0.7 - 0.8½
Nitric, 42 deg.	lb. 17	18 - 19
Oxalic, crys. tals.	lb. 17	17 - 19
Phosphoric, Ortho, 50 per cent solution	lb. 20	25 - 35
Pieric	lb. 20	1.90 - 2.15
Pyrogallol, resublimed	lb. 11	11.00 - 12.00
Sulphuric, 60 deg., tank cars	ton 18.00	20.00 - 20.00
Sulphuric, 60 deg., drums	ton 22.00	22.50 - 23.50
Sulphuric, 66 deg., tank cars	ton 23.00	24.00 - 24.00
Sulphuric, 66 deg., drums	ton 25.00	26.50 - 27.00
Sulphuric, fuming, 20 per cent (oleum)	ton 32.00	35.00 - 40.00
Tannic, U. S. P.	lb. 50	52 - 54
Tannic (tech.)	lb. 50	51 - 53
Tartaric, crystals	lb. 1.30	1.40 - 1.40
Tungstic, per lb. of WO ₃	lb. 4.65	4.90 - 4.90
Alcohol, Ethyl	gal. 32	38 - 45
Alcohol, Methyl (see methanol)	gal. 40	40 - 45
Alcohol, denatured, 188 proof	gal. 0.4	0.41 - 0.41
Alcohol, denatured, 190 proof	gal. 0.4	0.41 - 0.41
Alum, ammonia, lump	lb. 0.4	0.41 - 0.41
Alum, potassium	lb. 0.4	0.41 - 0.41
Alum, chrome, lump	lb. 13	13½ - 14
Aluminum sulphate, commercial	lb. 0.12	0.2 - 0.2
Aluminum sulphate, iron free	lb. 0.3	0.31 - 0.31
Aqua ammonia, 26 deg., drums (750 lb.)	lb. 0.7	0.7 - 0.8
Ammonia, anhydrous, cyl. (100-150 lb.)	lb. 30	32 - 35
Ammonium carbonate, powder	lb. 0.8	0.8 - 1.1
Ammonium chloride, granular (white salamonic) (nominal)	lb. 0.6	0.7 - 0.7
Ammonium chloride, granular (gray salamonic)	lb. 0.8	0.81 - 0.9
Ammonium nitrate	lb. 0.8	0.81 - 0.9
Ammonium sulphate	100 lbs. 2.50	2.75 - 2.80
Amylacetate	gal. 4.00	4.25 - 4.25
Amylacetate, tech.	gal. 2.50	3.00 - 3.00
Arsenic oxide, (white arsenic) powdered	lb. 1.7	1.8 - 1.8
Arsenic, sulphide, powdered (red arsenic)	lb. 12	12½ - 13
Barium chloride	ton 58.00	59.00 - 60.00
Barium dioxide (peroxide)	lb. 19	20 - 21
Barium nitrate	lb. 10	10½ - 11
Barium sulphate (precip.) (blanc fixe)	lb. 0.4	0.5 - 0.6
Bleaching powder (see calc. hypochlorite)	-	-
Blue vitriol (see copper sulphate)	-	-
Borax (see sodium borate)	-	-
Brimstone (see sulphur, roll)	-	-
Bromine	lb. 40	41 - 42
Calcium acetate	100 lbs. 2.00	2.05 - 2.05
Calcium carbide	lb. 0.5	0.51 - 0.5
Calcium chloride, fused, lump	ton 27.00	29.00 - 30.00
Calcium chloride, granulated	lb. 0.01	0.01 - 0.02
Calcium hypochlorite (bleach'g powder)	100 lb. 2.25	2.40 - 2.75
Calcium peroxide	lb. 1.25	1.25 - 1.50
Calcium phosphate, tribasic	lb. 1.5	1.5 - 1.6
Camphor	lb. 0.63	0.63 - 0.65
Carbon bisulphide	lb. 0.07	0.07 - 0.08
Carbon tetrachloride, drums	lb. 10	10½ - 11½
Carbonyl chloride (phosgene)	lb. 75	75 - 1.00
Caustic potash (see potassium hydroxide)	-	-
Chlorine, gas, liquid-cylinders (100 lb.)	lb. 0.08	0.09 - 0.10
Chloroform	lb. 0.38	0.38 - 0.40
Cobalt oxide	lb. 3.00	3.10 - 3.10
Copper (see iron sulphate)	-	-
Copper carbonate, green precipitate	lb. 20	21 - 22
Copper cyanide	lb. 50	50 - 62
Copper sulphate, crystals	lb. 0.05	0.05 - 0.06
Cream of tartar (see potassium bitartrate)	-	-
Epsom salt (see magnesium sulphate)	-	-
Ethyl Acetate Com. 85% to 100% ¹	gal. 90	1.00 - 1.00
Formaldehyde, 40 per cent	lb. 1.4	1.4 - 1.5
Fusel oil, ref.	gal. 3.00	3.25 - 3.25
Fusel oil, crude	gal. 1.75	2.00 - 2.00
Glauber's salt (see sodium sulphate)	-	-
Glycerine, C. P. drums extra	lb. 3.75	3.85 - 3.85
Iodine, res. sublimed	lb. 10	10 - 20
Iron oxide, red	lb. 1.00	1.25 - 1.50
Iron sulphate (coppers)	100 lb. 1.00	1.15 - 1.30
Lead acetate	lb. 0.09	0.09 - 0.10
Lead arsenite, paste	lb. 0.09	0.10 - 0.11
Lead nitrate	lb. 0.08	0.09 - 0.10
Litharge	lb. 1.25	1.25 - 1.25
Lithium car borate	lb. 0.09	0.09 - 0.11
Magnesium carbonate, technical	lb. 2.75	3.00 - 3.25
Magnesium sulphate, U. S. P.	100 lb. 1.10	1.25 - 1.25
Magnesium sulphate, 95%	gal. 75	77 - 77
Methanol, 97%	gal. 78	82 - 82
Nickel salt, double	lb. 14	14 - 14½
Nickel salt, single	lb. 15	15 - 15½
Phosgene (see carbonyl chloride)	-	-
Phosphorus, red	lb. 45	46 - 50
Phosphorus, yellow	lb. 35	35 - 37
Potassium bichromate	lb. 12	12 - 12½

	Carlots	Less Carlots		Carlots	Less Carlots		Carlots	Less Carlots	
Potassium bitartrate (cream of tartar)	lb. \$. . .	\$ 0.31 - \$0.32		Para-dichlorbenzene	lb. .15 -	20			
Potassium bromide, granular	lb. .35 -	.40 .16 - .25		Paranitroaniline	lb. .90 -	1.00			
Potassium carbonate, U. S. P.	lb. .06 -	.064 .45 - .50		Para-nitrotoluene	lb. .90 -	1.00			
Potassium carbonate, 80-85%	lb. .081 -	.10 .06 - .07		Para-phenylenediamine	lb. 1.95 -	2.00			
Potassium chlorate, crystals	lb. .10 -	.10 .10 - .14		Para-toluidine	lb. 1.25 -	1.40			
Potassium cyanide	lb. .06 -	.064 .30 - .32		Phthalic anhydride	lb. .50 -	.60			
Potassium hydroxide (caustic potash)	lb. .06 -	.064 .06 - .08		Phenol, U. S. P., drums (dest.), (240 lb.)	lb. .12 -	.14			
Potassium muriate	ton 50.00 -	53.00 .275 - .300		Pyridine	gal. 2.00 -	3.50			
Potassium iodide	lb. .09 -	.09 .10 - .12		Resorcinol, technical	lb. 1.75 -	1.85			
Potassium nitrate	lb. .35 -	.36 .37 - .38		Resorcinol, pure	lb. 2.25 -	2.30			
Potassium permanganate	lb. .35 -	.37 .38 - .40		Salicylic acid, U. S. P.	lb. .22 -	.24			
Potassium prussiate, red	lb. .26 -	.264 .27 - .28		Salol	lb. .85 -	.95			
Potassium prussiate, yellow	lb. .175 -	.180		Solvent naphtha, water-white, in drums, 100 gal.	gal. .25 -	.28			
Potassium sulphate (powdered)	per uni			Solvent naphtha, crude, heavy, in drums, 100 gal.	gal. .14 -	.16			
Rochele salts (see sodium pytas tartrate)				Sulphanilic acid, crude	lb. .30 -	.35			
Sal ammoniac (see ammonium chloride)				Tolidine	lb. 1.25 -	1.35			
Sal soda (see sodium carbonate)				Tolidine, mixed	lb. .40 -	.45			
Salt cake	ton .32.00 -	.33.00		Toluene, in tank cars	gal. .25 -	.28			
Silver cyanide	oz. 1.30 -	1.35		Toluene, in drums	gal. .28 -	.31			
Silver nitrate	oz. .41 -	.42		Xylylides, drums, 100 gal.	lb. .40 -	.45			
Soda ash, light	100 lb. 2.10 -	2.15 .2.25 - .2.50		Xylene, pure, in drums	gal. .40 -	.45			
Soda ash, dense	100 lb. 2.20 -	2.30 .2.40 - .2.75		Xylene, pure, in tank cars	gal. .45 -	.50			
Sodium acetate	lb. .04 -	.04 .05 - .05		Xylene, commercial, in drums, 100 gal.	gal. .33 -	.35			
Sodium bicarbonate	100 lb. 2.25 -	2.40 .2.50 - .2.75		Xylene, commercial, in tank cars	gal. .30 -	...			
Sodium bichromate	lb. .08 -	.081 .08 - .09							
Sodium bisulphite (nitre cake)	ton 5.00 -	5.25 .5.50 - .6.50							
Sodium bisulphite powdered, U. S. P.	lb. .051 -	.051 .051 - .06							
Sodium borate (borax)	lb. .06 -	.06 .07 - .07							
Sodium carbonate (soda ash)	100 lb. 2.00 -	2.10 .2.15 - .2.50							
Sodium chl. rate	lb. .07 -	.071 .08 - .08							
Sodium cyanide	lb. .22 -	.24 .25 - .30							
Sodium fluoride	lb. .12 -	.121 .13 - .14							
Sodium hydroxide (caustic soda)	100 lb. 3.00 -	3.75 .3.80 - .4.00							
Sodium hyposulphite	lb. .03 -	.04							
Sodium nitrate	100 lb. 2.90 -	3.00 -							
Sodium nitrite	lb. .071 -	.08 .081 - .10							
Sodium peroxide, powdered	lb. .25 -	.26 .27 - .30							
Sodium phosphate, dibasic	lb. .041 -	.041 .05 - .05							
Sodium potassium tartrate (Rochelle salts)	lb. .07 -	.071 .08 - .08							
Sodium prussiate, yellow	lb. .12 -	.121 .13 - .14							
Sodium silicate, solution (40 deg.)	lb. 1.25 -	1.35 .1.40 - .1.50							
Sodium silicate, solution (60 deg.)	lb. .021 -	.03 .031 - .031							
Sodium sulphate, crystals (Glauber's salt)	100 lbs. 1.50 -	1.75 .2.00 - .2.25							
Sodium sulphide, fused, 60-62 per cent (cone)	lb. .051 -	.051 .06 - .06							
Sodium sulphite, crystals	lb. .031 -	.04 .041 - .041							
Strontrium nitrate, powdered	lb. .15 -	.151 .16 - .17							
Sulphur chl. ride, red	lb. .07 -	.071 .07 - .08							
Sulphur, crude	ton 20.00 -	22.00 .09 - .10							
Sulphur dioxide, liquid, cylinders extn.	lb. .08 -	.081 .09 - .10							
Sulphur (sublimed), flour	100 lb. .08 -	.081 .2.25 - .3.10							
Sulphur, roll (brimstone)	100 lb. .08 -	.081 .2.00 - .2.75							
Tin chloride, 50 per cent	lb. .18 -	.19 .20 - .40							
Tin oxide	lb. .16 -	.18 .19 - .20							
Zinc carbonate, precipitate	lb. .11 -	.111 .11 - .12							
Zinc chloride, gran.	lb. .45 -	.49 .50 - .60							
Zinc cyanide	lb. .12 -	.13 .13 - .14							
Zinc dust	lb. .08 -	.09 .091 - .10							
Zinc oxide, XX	lb. .031 -	.031 .04 - .05							
Zinc sulphate									

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

	lb.	\$ 1.10 - \$1.15		73-76 deg., steel bbls. (85 lb.)	gal.	\$ 0.41
Alpha-naphthol, crude				70-72 deg., steel bbls. (85 lb.)	gal.	.39
Alpha-naphthol, refined				68-70 deg., steel bbls. (85 lb.)	gal.	.38
Alpha-naphthylamine				V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30
Aniline oil, drums extra						
Aniline salts						
Anthracene, 80% in drums (100 lb.)						
Benzaldehyde, U. S. P.						
Benzidine, base						
Benzidine sulphate						
Benzoic acid, U. S. P.						
Benzoate of soda, U. S. P.						
Benzene, pure, water-white, in drums (100 gal.)						
Benzene, 90%, in drums (100 gal.)						
Benzyl chloride, 95-97%, refined						
Benzyl chloride, tech						
Beta-naphthol benzene						
Beta-naphthol, sublimed						
Beta-naphthol, tech						
Beta-naphthylamine, sublimed						
Cresol, U. S. P., in drums (100 lb.)						
Ortho-cresol, in drums (100 lb.)						
Cresylie acid, 97-99%, straw color, in drums						
Cresylie acid, 75-97%, dark, in drums						
Cresylie acid, 50%, first quality, drums						
Dichlorbenzene						
Diethylaniline						
Dimethylaniline						
Dinitrobenzene						
Dinitrochlorobenzene						
Dinitronaphthalene						
Dinitrophenol						
Dinitrotoluene						
Dip oil, 25%, tar acids, car lots, in drums	gal.	.40 - .45				
Diphenylamine						
H-acid						
Meta-phenylenediamine						
Monochlorbenzene						
Monomethylaniline						
Naphthalene crushed, in bbls. (250 lb.)	lb.	.071 - .081				
Naphthalene, flake	lb.	.071 - .081				
Naphthalene, oils	lb.	.08 - .09				
Naphthoquinone acid, crude	lb.	.12 - .15				
Nitrobenzene						
Nitro-naphthalene						
Nitro-toluene						
Ortho-aminodiphenol						
Ortho-dichlor-benzena						
Ortho-nitro-phenol						
Ortho-nitro-toluene						
Ortho-toluidine						
Para-amidophenol, base	lb.	.150 - .160				
Para-amidophenol, HCl	lb.	.175 - .180				
Para-dichlorbenzene						
Paranitroaniline						
Para-nitrotoluene						
Para-toluidine						
Phthalic anhydride						
Phenol, U. S. P., drums (dest.), (240 lb.)						
Pyridine						
Resorcinol, technical						
Resorcinol, pure						
Salol						
Solvent naphtha, water-white, in drums, 100 gal.						
Solvent naphtha, crude, heavy, in drums, 100 gal.						
Sulphanilic acid, crude						
Tolidine						
Tolidine, mixed						
Toluene, in tank cars						
Toluene, in drums						
Xylylides, drums, 100 gal.						
Xylene, pure, in drums						
Xylene, pure, in tank cars						
Xylene, commercial, in drums, 100 gal.						
Xylene, commercial, in tank cars						

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.	
Rosin B-D, bbl.	280 lb. \$ 5.20
Rosin E-I	280 lb. 6.30
Rosin K-N	280 lb. 6.50
Rosin W, G.-W. W	280 lb. 6.80
Wood rosin, bbl.	280 lb. 6.25
Spirits of turpentine	gal. .69
Wood turpentine, steam dist.	gal. .67
Wood turpentine, dest. dist.	gal. .65
Pine tar pitch, bbl.	200 lb. 7.00
Tar, kiln burned, bbl. (500 lb.)	bbl. 12.50
Retort tar, bbl.	500 lb. 12.50
Rosin oil, first run	gal. 40
Rosin oil, second run	gal. 44
Rosin oil, third run	gal. 47
Pine oil, steam dist., sp.gr., 0.930-0.940	gal. \$ 1.80
Pine oil, pure, dest. dist.	gal. 1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal. .46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal. .35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal. .75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal. .35
Turpentine, crude, sp.gr., 0.900-0.970	gal. 1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal. .35
Pinewood creosote, ref.	gal. .52

Solvents

Crude Rubber	lb.	\$ 0.17	17
Para-Upriver fine	lb.	.112	12
Upriver coarse	lb.	.14	14
Upriver caucho ball	lb.	.184	17
Plantation—First latex crepe	lb.	.164	16
Ribbed smoked sheets	lb.	.15	15
Brown crepe, thin, clean	lb.	.17	17
Amber crepe No. 1	lb.	.17	17

Oils

VEGET

Olive oil, Denatured	gal.	\$1.40	—	\$1.60
Palm, Lagos	lb.	.07	—	.07
Palm, Niger	lb.	.05	—	.06
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.06	—	.06
Peanut oil, refined, in bbls.	lb.	.10	—	.10
Rapeseed oil, refined in bbls.	gal.	.86	—	.88
Rapeseed oil, blown, in bbls.	gal.	.92	—	.94
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.07	—	—
Soya bean oil, tank cars, f.o.b. Pacific coast	lb.	.05	—	—

FISH

Light pressed menhaden	gal.	\$0.40	—	\$0.41
Yellow bleached menhaden	gal.	.42	—	—
White bleached menhaden	gal.	.44	—	—
Blown menhaden	gal.	.80	—	—

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	\$24.00	—	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00	—	26.00
Barytes, crude, 88% @ 94% ba., Kings Creek	net ton	10.00	—	1.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50	—	28.00
Barytes, crude, first grade, Missouri	net ton	7.00	—	—
Blanc fixe, dry	lb.	.05	—	.05
Blanc fixe, pulp	net ton	50.00	—	60.00
Casein	lb.	.14	—	.16
Chalk, domestic, extra light	lb.	.05	—	.05
Chalk, domestic, light	lb.	.04	—	.05
Chalk, domestic, heavy	lb.	.04	—	.05
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.05	—	.06
Chalk, English, dense	lb.	.04	—	.05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00	—	10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00	—	15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00	—	22.00
China clay (kaolin) crude, f.o.b. Virginia points	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00	—	40.00
China clay (kaolin), imported, lump	net ton	23.00	—	25.00
China clay (kaolin), imported, powdered	net ton	30.00	—	35.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00	—	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00	—	30.00
Fuller's earth, f.o.b. Mines	net ton	16.00	—	17.00
Fuller's earth, granular, f.o.b. Pa.	net ton	15.00	—	18.00
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00	—	—
Fuller's earth, imported, powdered	net ton	24.00	—	27.00
Graphite, Ceylon lump, first qual y	lb.	.07	—	.08
Graphite, Ceylon chip	lb.	.06	—	.06
Graphite, high grade amorphous crude	lb.	.02	—	.03
Pumice stone, imported, lump	lb.	.04	—	.50
Pumice stone, domestic, lump	lb.	.05	—	.05
Pumice stone, ground	lb.	.06	—	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	—	—	10.00
Quartz (acid tower) 1 1/2 in., f.o.b. Baltimore	net ton	—	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	—	—	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	—	7.50
Shellac, orange fine	lb.	.65	—	—
Shellac, orange superfine	lb.	.71	—	—
Shellac, A. C. garnet	lb.	.45	—	.46
Shellac, T. N.	lb.	.69	—	—
Soapstone	ton	12.00	—	15.00
Sodium chloride	long ton	12.50	—	13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00	—	20.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50	—	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00	—	18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00	—	14.00
Talc, imported	ton	35.00	—	40.00
Talc, California talcum powder grade	ton	18.00	—	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	per ton	\$35.00-50.00
Carborundum refractory brick, 9-in. { less than carlot	carlot lots	1,000 1250.00
Chrome brick, f.o.b. Eastern shipping points	net ton	75-90
Chrome cement, 40-45% Cr ₂ O ₃	net ton	45-50
Chrome cement, 40-45% Cr ₂ O ₃ , sacks, in car lots, f.o.b. Eastern shipping points	net ton	55
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	40-50
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	40-50
Magnesite brick, 9-in. straight	net ton	90
Magnesite brick, 9-in. arches, wedges and keys	net ton	100
Magnesite brick, soaps and splits	net ton	110
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	45-55
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	45-55
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	45-55

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	\$200.00	—	\$225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.15	—	.16
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.16	—	.17
Ferrochrome, 76-80% Mn, domestic	gross ton	80.00	—	85.00
Ferrochrome, 76-80% Mn, English	gross ton	80.00	—	85.00
Spiegeleisen, 18-22% Mn	gross ton	32.00	—	35.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.50	—	—
Ferrosilicon, 10-15%	gross ton	50.00	—	55.00
Ferrosilicon, 50%	gross ton	80.00	—	85.00
Ferrosilicon, 75%	gross ton	145.00	—	150.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.45	—	.50
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00	—	—
Ferrovanadium, 30-40% per lb. of contained V	lb.	5.00	—	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	\$8.00	—	\$10.00
Chrome ore, Calif. concentrate, 50% min. Cr ₂ O ₃	unit	45	—	50
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard	unit	45	—	50
Coke, foundry, f.o.b. ovens	net ton	4.50	—	5.00
Coke, furnace, f.o.b. ovens	net ton	3.25	—	3.75
Coke, petroleum, refinery, Atlantic seaboard	net ton	15.00	—	16.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	15.00	—	—
Fluorspar, standard, domestic washed gravel	—	—	—	—
Kentucky and Illinois mines	net ton	20.00	—	22.50
Ilmenite ore, 52% TiO ₂ , per lb. ore	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	25	—	30
Manganese ore, chemical (MnO ₂)	gross ton	60.00	—	65.00
Molybdenite, 85% Mo ₂ , per lb. of Mo ₂ S ₂ , N. Y.	lb.	.55	—	.60
Monazite, per unit of ThO ₂ , c.i.f. Atlantic seaport	unit	30.00	—	—
Pyrites, Spanish, fines, c.i.f. Atlantic seaport	unit	.14	—	.14
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	—	.13
Rutiles, 95% TiO ₂ per lb. ore	lb.	.15	—	—
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal)	unit	3.00	—	3.50
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.	unit	3.00	—	3.50
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.50	—	2.50
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained	lb.	1.50	—	—
Zircon, washed, iron free	lb.	.03	—	—

Non-Ferrous Metals

New York Markets

Cents per lb.

Copper, electrolytic	lb.	13.00
Aluminum, 98 to 99 per cent	lb.	28.00-28.5
Antimony, wholesale lots, Chinese and Japanese	lb.	51@51
Nickel, ordinary (ingot)	lb.	41.00
Nickel, electrolytic	lb.	44.00
Monel metal, spot and blocks	lb.	35.00
Monel metal, ingots	lb.	38.00
Monel metal, sheet bars	lb.	40.00
Tin, 5-ton lots, Straits	lb.	33.00
Lead, New York, spot	lb.	5.00
Lead, E. St. Louis, spot	lb.	4.85
Zinc, spot, New York	lb.	5.35
Zinc, spot, E. St. Louis	lb.	4.85

OTHER METALS

Silver (commercial)	oz.	\$60
Cadmium	lb.	1.00-1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	4.00
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	72.00-75.00
Iridium	oz.	250.00@300.00
Palladium	oz.	65.00@70.00
Mercury	75 lb.	46.00-47.00

FINISHED METAL PRODUCTS

Warehouse Price

Cents per lb.

Copper sheets, hot rolled	20.50-20.75
Copper bottoms	28.00-28.25
Copper rods	19.25-20.00
High brass wire	18.25
High brass rods	15.25
Low brass wire	20.25
Low brass rod	29.00
Brazed brass tubing	34.25
Brazed bronze tubing	22.00
Seamless copper tubing	21.00
Seamless high brass tubing	3.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

— New York —

Current Year Ago Cleveland Chicago

Copper, heavy and crucible	8.50@9.00	18.50	10.00	10.50
Copper, heavy and wire	8.00@8.25	16.50	9.50	9.50
Copper, light and bottoms	7.00@7.50	14.50	9.00	8.50
Lead, heavy	3.25@3.50	7.25	4.00	4.00
Lead, tea	2.15@2.30	5.25	3.00	3.00
Brass, heavy	4.25@4.50	9.50	2.00	10.00
Brass, light	3.00@3.25	8.00	5.00	5.50
No. 1 yellow brass turnings	4.00@4.25	9.50	5.50	6.00
Zinc	2.00@2.50	5.00	3.00	3.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1 in. and larger, and plates 1 in

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

ANNISTON—The Poland Soap Works, recently organized, is arranging for a lease of a local building for the establishment of a new plant for the manufacture of soap and soap powders in bulk. It is proposed to develop an annual capacity of about 3,000,000 lb. of material. Carter D. Poland is president, and O. L. Williams secretary-treasurer.

MOBILE—W. A. Benson and associates are organizing a company for the establishment of a new local plant for the manufacture of paints, varnishes, etc. A building has been acquired and machinery will be installed at once. The initial output will be on the basis of about 2,000 gal. per day.

Arkansas

TEXARKANA—H. K. Tutty, New Orleans, La., and associates are organizing a company to establish a local pulp mill.

Arizona

BISBEE—The new ore reduction mill, now in course of construction at the property of the Copper Queen Mining Co., is estimated to cost close to \$4,000,000 with machinery and equipment. It will be one of the largest plants of its kind in the country.

PREScott—The Big Ledge Copper Co. is arranging for a stock issue to total about \$500,000, the proceeds to be used for general operations and financing.

California

LOS ANGELES—The National Airless Tire Co., Grosse Bldg., manufacturer of rubber tires, has preliminary plans under way for the erection of a new 3-story plant at Norwalk, Cal., 100x250 ft. A. C. Martin, 430 Higgins Bldg., is architect. C. H. Braden is secretary and general manager.

SAN FRANCISCO—The Pacific Coast Steel Co., Rialto Bldg., is having plans prepared for the erection of a new 1-story plant at South San Francisco to be 80x100 ft.

BURBANK—The Crystal & Colored Glass Co. has awarded a contract to W. Lee Ray, Burbank, for the erection of a new 1-story plant, 70x130 ft., at First and Cypress Sts.

SAN MATEO—The Minerals, Metals & By-Products Co., Denver, Col., has selected property owned by the Howard Estate Co., on the San Mateo Bay shore, comprising about 1,385 acres of land, as a site for the erection of its proposed new metallurgical plant. Present submerged land on the tract will be reclaimed. The new works are estimated to cost in excess of \$1,000,000 with machinery. L. C. Rogers is president.

Florida

CANAL POINT—The Florida Sugar & Food Products Co. is planning for the erection of a large sugar mill on a local tract of land. The company has an aggregate of 8,000 acres of land. The new plant will have an initial capacity for handling about 5,000 tons of sugar cane per month. F. E. Bryant is head.

Illinois

CHICAGO—The Waterway Paper Co., Kedzie Ave. and 32d St., has plans under way for the erection of a new 1-story plant on Kedzie Ave., 80x180 ft., estimated to cost about \$175,000. Frank D. Chase, Inc., 645 North Michigan Ave., is engineer.

CHICAGO—The Atlas Copper & Brass Mfg. Co., 2734 High St., is taking bids for the construction of a new 1-story plant addition, 50x125 ft., to cost about \$21,000. Louis Ehle, 3810 B'way, is architect.

Indiana

SOUTH BEND—The International India Rubber Corp., 310 West Ewing Ave., has

had plans prepared for the erection of a 2-story and basement addition to its plant. W. W. Schneider, 120 South Main St., is architect.

Maryland

BALTIMORE—The Holdite Mfg. Co. has taken out a building permit for the erection of a new 1-story plant, 50x132 ft., for the manufacture of rubber specialties. It will be located at Warner and Ostend Sts. Stanislaus Russell, 11 East Lexington St., is architect.

BALTIMORE—Plans for the new plant of the Gwynns Falls Paper Co., 517 Calvert Bldg., have been completed and it is expected to call for erection bids at an early date. The plant will be located at Gwynns Falls, near Baltimore; it will be 1-story, brick and concrete, and estimated to cost about \$250,000 with machinery. Joseph H. Wallace & Co., 5 Beekman St., New York, are engineers. George W. Davis is head.

BELLEVUE, MD.—William H. Valliant is reported to be planning for the rebuilding of his fertilizer manufacturing plant and lime works, destroyed by fire May 10, with loss estimated at about \$250,000 with machinery.

BALTIMORE—Swindell Bros., Bayard and Russell Sts., manufacturers of glass products, have acquired property on Russell St., 100x165 ft., in the vicinity of their plant, to be used in connection with general operations. It is said that a new building will be located on the site, but this has not been confirmed.

Massachusetts

TAUNTON—The Presbrey Stove Lining Co., Wier Village, manufacturer of refractory products, has awarded a contract to Franklin D. Williams, Taunton, for the erection of a new 2-story plant building to cost about \$25,000. It will replace a portion of the works recently destroyed by fire with loss of about \$125,000.

Missouri

KANSAS CITY—A. W. Estrabrook, 729 Holmes St., has broken ground for the erection of a new 2-story and basement chemical laboratory and manufacturing works on Holmes St., 40x60 ft. William Jewell, 417 Rialto Bldg., has the construction contract.

ST. LOUIS—The Herman Oak Leather Co., 4020 North Main St., has awarded a contract to Arthur Dorr, 4145 Manchester Ave., for the construction of the proposed 2-story and basement addition to its plant, 24x70 ft., to cost about \$25,000. L. C. Herman is head.

New Jersey

TRENTON—The Magnetic Pigment Co., Cass St., will make extensions and improvements in its plant to cost about \$12,000.

TRENTON—The Star Porcelain Co., Muirfield Ave., has filed plans for the erection of a new 1-story plant addition.

NEWARK—The Interstate Smelting & Refining Co., 29 Commercial St., has acquired property at Hawkins St. and Plum Point Lane for proposed future additions to its plant. Erection of proposed buildings will be deferred, it is said, for a few months.

VINELAND—The Doerr Glass Co., manufacturer of chemical and scientific glassware specialties, has completed the erection of additions to its plant to be used for the manufacture of glass tubing, rods and kindred articles.

LYNDHURST—The Butterworth-Judson Co., Newark, N. J., manufacturer of chemicals, dyestuffs, etc., has disposed of its local plant to the Goodwin Reid Co., also of Newark, which will use the works, it is said, for kindred manufacture. The property consists of buildings aggregating about 20,000 sq. ft. in floor area, located on a two-acre tract. The plant at one time was occupied by the Renslau Chemical Co.

NEWARK—The National Cork Products, Inc., recently organized, has leased the 2-story factory at 357-9 Ogden St., near Carlyle Pl., for the establishment of a new plant for the manufacture of cork specialties. Possession will be taken at once and necessary equipment installed. D. D. Lehrman is vice-president.

New York

BROOKLYN—The J. Lackner Co., 308 Seventh Ave., manufacturer of paper specialties, has revised plans under way for the erection of a 2-story addition to its plant, 85x97 ft., to cost about \$19,000.

NEW YORK—The Standard Oil Co., 26 B'way, has arranged for a bond issue of \$20,000,000 to be used in part for extensions to its oil refineries, and general operations. The company operates a large refinery at Constable Hook, Bayonne, N. J.

BUFFALO—The Williams Gold Refining Co., 2978 Main St., has awarded a contract to the Hydro Construction Co., Mutual Life Bldg., for the erection of a 1-story addition, 50x63 ft., to be used for general manufacture. It will cost about \$15,000. R. V. Williams is treasurer.

North Carolina

SALISBURY—The Paul Rubber Co., recently incorporated with a capital of \$250,000, has plans under way for the erection of the first unit of its proposed new local plant for the manufacture of tires, to be 2-story, 60x160 ft., with 1-story building adjoining, 60x100 ft., estimated to cost about \$35,000. The company has a tract of 7½ acres of land, and the initial buildings will be supplemented by other structures at a later date. W. H. McConnell is head.

Ohio

CLEVELAND—The Hinde Paper Co., recently organized with a capital of \$1,000,000, is planning for the erection of a new local plant for the manufacture of fiber board products. The company is headed by James J. Hinde, one of the founders of the Hinde & Dauch Paper Co., Sandusky, Ohio, manufacturer of corrugated paper specialties.

Oklahoma

GRANFIELD—The Motor Oil & Refining Co., recently organized, is planning for the erection of a new oil refinery at Chickasha, Okla., with initial daily capacity of 500 bbl. of crude oil. It is proposed to build a compounding works, adjacent to the main refinery, for the production of lubricating oils. R. C. Williamson is president, and R. R. Ryule secretary and treasurer.

Pennsylvania

DU BOIS—The Independent Sanitary Mfg. Co., 218 Lexington Ave., Buffalo, N. Y., manufacturer of sanitary metal products, has plans under way for the erection of a new foundry on a local site. Cundall, Powell & Mosher, 80 West Genesee St., Buffalo, are architects.

YORK—Fire May 12 destroyed a portion of the plant of the American Phosphorous Co., with loss reported at about \$12,000.

PHILADELPHIA—The Federal Container Co., 25th and Locust Sts., manufacturer of corrugated paper containers, etc., has acquired property on Paschall Ave., near 56th St., 130x325 ft., for the erection of its proposed new 2-story plant, 82x302 ft., estimated to cost about \$150,000 with equipment.

Tennessee

CLEVELAND—The Kyva Ferro-Manganese Corp., Winchester, Ky., has acquired the electric furnace plant of the Tennessee Manganese Co., Cleveland, with daily capacity of about 10 tons, and will operate the plant in connection with its manganese property developments in this section. The plant will be used for the production of ferromanganese, ferrosilicon and kindred products. W. B. Lindsay is president.

Texas

TEXARKANA—The Diamond Sugar Chemical Co., recently organized, has leased a local building for the immediate establishment of a new plant for the manufacture of chemical specialties. Machinery, including laboratory equipment, will be installed. Clifton T. Spear, Box 378, is president and manager.

BRIDGEPORT—The Phoenix Clay Corp. has inaugurated the erection of a new plant for the manufacture of brick and other burned clay products. The company is reported to have acquired the plant of the Bridgeport Brick & Tile Co., and with this acquisition will develop a total daily output of over 125,000 bricks. C. W. Martin is president.

West Virginia

FAIRMONT—The Federal Carbonic Co. has perfected plans for the erection of a new local plant for the production of carbonic acid gas and kindred products. E. A. Bailey is president.

Capital Increases, Etc.

THE ELLISON BRASS MFG. CO., Jamestown, N. Y., has filed notice of increase in capital from \$60,000 to \$250,000.

THE MARTIN VARNISH CO., 2520 Quarry St., Chicago, has filed notice of increase in capital from \$100,000 to \$250,000.

THE HOUSTON PAPER CO., Houston, Tex., has filed notice of increase in capital from \$30,000 to \$50,000.

THE WILLIAMS SUBMARINE COMPOUND CO., 21 State St., New York City, has filed notice of change of name to the Williams Scaling & Paint Co.

THE DE LUXE INK & DYE CO., Chicago, has filed notice of increase in capital from \$40,000 to \$400,000.

THE RELIANCE FOUNDRY CO., Richmond, Ind., has filed notice of increase in capital from \$30,000 to \$60,000.

THE CONNECTICUT ZINC CORP., Wyandank (Suffolk Co.), N. Y., has filed notice of increase in capital from \$1,000,000 to \$2,000,000.

THE MILLER-LAMBERT CHEMICAL CO., Columbia, S. C., is arranging for an increase in capital to \$25,000. Mayhew Lambert is president.

THE PINES RUBBER CO., Brooklyn, N. Y., has filed notice of increase in capital from \$75,000 to \$200,000.

New Companies

THE NATIONAL ZYLONOID CO., New York City, has been incorporated with a capital of \$500,000 to manufacture celluloid and other composition products. The incorporators are C. H. Louis, M. Dulugasch and W. Polglass. The company is represented by Olcott, Bonynge, McManus & Ernest, 170 B'way.

THE CONSOLIDATED SALT CO. OF CALIFORNIA, Los Angeles, Cal., has been incorporated with a capital of \$750,000 to manufacture salt products, industrial chemicals, etc. The incorporators are Alfred G. Blair, Samuel Merrill, Jr., Pasadena, Cal.; John Coolman, F. H. Owen, Colton, Cal. Manning & Thompson, Los Angeles, represent the company.

THE AETNA CHEMICAL CO., Boston, Mass., has been incorporated with a capital of \$200,000 to manufacture chemical products. Walter F. Clarke is president, and Robert Thompson, 228 Huntington Ave., treasurer.

THE FURNACE LINING MATERIALS CO., 53 West Jackson Blvd., Chicago, has been incorporated with a capital of \$50,000 to manufacture refractory products. The incorporators are C. L. Leesley, F. C. Corley and W. D. Shepard.

THE EVERFIRE SPARK PLUG CO., New York, has been incorporated with a capital of \$25,000 to manufacture spark plugs, etc. The incorporators are R. and A. Lyons, and J. Hirschman, Hirschman & Roeder, 1475 B'way, represent the company.

THE KELSEY CITY BRICK & SUPPLY CO., Kelsey City, Fla., has been incorporated with a capital of \$500,000 to manufacture brick and other burned clay products. Harry S. Kelsey is president, Fred A. Clarry vice-president and secretary, and James McDonald treasurer.

THE HURST OIL CO., Los Angeles, Cal., has been incorporated with a capital of \$5,000,000 to manufacture petroleum products. The incorporators are J. T. Hurst, Jerome B. Frank and S. M. Haskins, Gibson, Dunn & Crutcher, Los Angeles, represent the company.

THE MAGIC DYE-SOAP CO., 75-77 West Van Buren St., Chicago, has been incorporated with a capital of \$100,000 to manufacture soaps and affiliated products. The incorporators are Robert B. Whiting, T. N. Daggett and M. A. Jeffers.

THE MAXWELL CHEMICAL CO., Dallas, Tex., has been incorporated with a capital of \$25,000 to manufacture chemicals and chemical byproducts. The incorporators are P. P. Roberg and Henry Exall.

THE CONTINENTAL LEATHER Goods CO., Newark, N. J., has been incorporated with a capital of \$100,000 to manufacture leather products. The incorporators are Max Olshan, Irving Wexler and Louis J. Cohen, 207 Broad St.

THE WILSON SPECIALTY CO., New York City, has been incorporated with a capital of \$100,000 to manufacture chemicals and chemical compounds. The incorporators are W. Wilson, S. Senate and J. J. Kraus. L. I. Isquith, 299 B'way, represents the company.

THE STANDARD RUBBER CEMENT CO., Stoughton, Mass., has been incorporated with a capital of \$10,000 to manufacture rubber cement and kindred products. The incorporators are M. S. Azulay, E. M. Azulay and J. C. Eccles.

THE SUPERIOR GLASS APPARATUS CO., 6 Van Wagenen Ave., Newark, N. J., has filed notice of organization to manufacture chemical glassware. Emil Sella, 288 Broad St., heads the company.

THE PLACERITA PETROLEUM CO., Los Angeles, Cal., has been incorporated with a capital of \$500,000 to manufacture petroleum products. The incorporators are John K. McGregor, W. J. Van Houten and Amos Campbell. George R. Wickham, Hermosa Beach, Cal., represents the company.

THE ONE-CO. VARNISH WORKS, New York City, has been incorporated with a capital of \$20,000 to manufacture paints, oils, varnishes, etc. The incorporators are N. and S. Kent and S. Blumenthal. Kent & Kent, 287 B'way, represent the company.

THE SHULTZ MFG. CO., Binghamton, N. Y., has been incorporated with a capital of \$75,000 to manufacture paper and paper products. The incorporators are J. F. Murphy, J. B. Rushmore and A. J. Prie, 4 East Howard St.

THE STAZON MFG. CO., Brooklyn, N. Y., has been incorporated with a capital of \$50,000 to manufacture cleaning products, chemical compounds, etc. The incorporators are B. H. Fry, M. L. Einstein, Stern & Reubens, 149 B'way, represent the company.

THE HERIOT LIME CO., Birmingham, Ala., has been organized to manufacture hydrated lime and other lime products. The company is headed by W. B. Heriot and J. S. Bailey.

THE WENGER-ARMSTRONG CORP., 608 South Dearborn St., Chicago, has been incorporated with a capital of \$50,000 to manufacture petroleum and petroleum byproducts. The incorporators are Ernest A. Wenger, Archer S. Armstrong and Edward R. Tiedebohl.

THE BRADLEY MOTOR OIL CO., New York City, has been incorporated with a capital of \$20,000 to manufacture refined oil products. The incorporators are H. A. Bradley, L. Wiencke and S. Root. I. Witkind, 299 B'way, represents the company.

THE AMARILLO PAPER CO., Amarillo, Tex., has been incorporated with a capital of \$20,000 to manufacture paper products. The incorporators are Benjamin Hirschland and J. S. McKnight.

THE BLYTHE CHEMICAL CO., Brooklyn, N. Y., has been incorporated with a capital of \$5,000 to manufacture chemicals and chemical byproducts. The incorporators are A. Falk, K. Hart and D. Geiger, 286 Fifth Ave.

THE GECK LABORATORIES, INC., New York City, has been incorporated with a capital of \$20,000 to manufacture chemicals and chemical byproducts. The incorporators are F. A. Geck, J. S. Scheuer and H. H. Jacobs, Joseph & Zeamans, 1834 B'way, represent the company.

THE PENN PAPER CO., Erie, Pa., has been incorporated with a capital of \$50,000 to manufacture paper products. John F. Young, 604 East 21st St., is treasurer.

THE MARYLAND OIL CO., 16 St. Paul St., Baltimore, Md., has been incorporated with a capital of \$250,000 to manufacture refined oil products. The incorporators are William B. Henkel, Wirt A. Duvall, Jr., and M. P. Kenly.

THE HUNTINGTON-MAIN OIL CO., Los Angeles, Cal., has been incorporated with a capital of \$300,000 to manufacture petroleum products. The incorporators are Torrance C. Welch, Pasadena, Cal.; C. C. Dicey and H. M. Farris, Los Angeles.

THE T. G. EGAN REFRactories ENGINEERING CO., Brooklyn, N. Y., has been incorporated with a capital of \$10,000 to manufacture refractory products. The incorporators are T. G. Egan, I. P. Morris and M. H. Lewis. H. S. Dudner, 11 B'way, represents the company.

THE BIG X OIL CORP., Bigheart, Okla., has been incorporated with a capital of \$100,000 to manufacture petroleum products. The incorporators are E. B. Gray and E. M. Coffey, Bigheart.

THE LA ESTRELLA CASTILE SOAP CO., New York, N. Y., has been incorporated with a capital of \$5,000 to manufacture soap and kindred products. The incorporators are G. Korn, A. P. Fernandez and M. M. Simon, 805 B'way.

THE PLANIA CARBON CORPORATION, 36 West Randolph St., Chicago, has been incorporated with a capital of \$100,000 to manufacture carbon products. The incorporators are Fred W. Hartmann, George H. Webster and William R. Diamond.

THE INTERNATIONAL CORRUGATED BOX CO., New York City, has been incorporated with a capital of \$15,000 to manufacture corrugated paper products. The incorporators are S. and D. Honigstock, and A. I. Menin, 1 Madison Ave.

THE AUTO PAINT CO., Newark, N. J., has been incorporated with a capital of \$50,000 to manufacture paints, varnishes, etc. The incorporators are George W. Nuse, Maurice R. H. Bowman and David J. Hall, Newark.

THE MINERAL PAINT CO., Los Angeles, Cal., has filed notice of organization to manufacture paints, oils, etc. Frank L. Buchanan, East 55th St., heads the company.

THE CANYON PETROLEUM CO., Room 1208, 36 South State St., Chicago, Ill., has been incorporated with a capital of \$1,000,000 to manufacture petroleum products. The incorporators are John Kabanys, George D. Leonard and H. M. Meyers.

THE STANDARDIZED CHEMICAL CO., Room 1330, 122 South Michigan Ave., Chicago, has been incorporated with a capital of \$25,000 to manufacture chemicals and chemical byproducts. The incorporators are E. Craig, Frank F. Perner and Joseph H. Hazen.

Manufacturers' Catalogs

GENERAL MACHINE CO., Newark, N. J., has issued a booklet on Ball Thrust Bearing Overhunting Agitating Devices and Chemical Equipment.

THE DE LA VERGNE MACHINE CO., New York, calls attention to three new publications, on Municipal Power Plants, De La Vergne Oil Engine, Type SI, and The De La Vergne Diesel Oil Engine.

THE ELECTRIC FURNACE CO., Salem, O., has issued a book of photographs of Bally electric furnaces in brass foundries and rolling mills in the United States and also in foreign countries, which is known as Booklet 10-B.

THE SULLIVAN MACHINERY CO., Chicago, Ill., announces three new publications. Bulletin 72-E, on Drill Sharpening Machines, describes the new Class B light weight drill sharpener, as well as the standard Class A machines, with especial references to the making of genuine double taper bits, etc. Bulletin 77-B, on Angle Compound Air Compressors, includes mention of the company's single stage or duplex angle machines for low pressure. Bulletin 77-A illustrates Sullivan mine car compressors, which are operated by electric motor.

THE FILES ENGINEERING CO., INC., Providence, R. I., has issued a booklet entitled "Files Stoker" which describes a hand-operated stoker and gives some interesting data regarding the stoker and efficient fuel burning.

THE NORTON CO., Worcester, Mass., has issued a booklet on "Grinding in the Railroad Shops."

W. S. ROCKWELL CO., New York, calls attention to Bulletin 223, which illustrates and describes various types of burners for the use of oil and gas fuel for industrial heating. Bulletin 224 is on "Form Value of Energy in Relation to Its Production, Transportation and Application."

THE MAHR MFG. CO., Minneapolis, Minn., has issued sheet 523, describing a style "T" self-contained kerosene torch for use in foundry and machine shops and chemical plants.

THE VIDETTO-RUANE MACHINERY CO., Pittsburgh, Pa., recently issued a new bulletin covering portable belt conveyors. These conveyors are known as the Atlas brand and range in size from 18 to 24 in. belt width. They are used for loading and unloading box cars and gondolas and for piling various materials in and about the plant. They may be driven by gasoline engine or electric motors and are equipped with a swivel axle for placing the wheels in any position in regard to the direction of travel of the belt.

THE PITTSBURGH REINFORCED BRAZING & MACHINE CO., Pittsburgh, Pa., has published a circular on its new high-pressure oxygen compressor which has just been placed on the market. It is illustrated in front and side view.

THE AMERICAN ENGINEERING CO., Philadelphia, Pa., is distributing a pamphlet entitled "Are Mechanical Stokers a Good Investment?" Interesting pen and ink illustrations are given.

FULLER-LEHIGH CO., Fullerton, Pa., calls attention to Catalog 700, on "Fuller Pulverized Coal Equipment for Locomotives." This booklet illustrates and describes pulverized coal-burning equipment which is the result of six years of trial, research and development, together with sixteen years' experience in design and application.

HENRY VOGT MACHINE CO., Louisville, Ky., has published a booklet on "Vogt for Better Refinery Equipment." The Vogt paraffine wax plant equipment is briefly outlined, and illustrations and descriptive matter are given of other Vogt equipment, including chilling machine, refrigerating machine, paraffine wax press, auto truck tank, water tube boiler, horizontal return tubular boiler, sectional steel boiler casing, stills for oil refineries, drop forged steel valves and fittings, and sectional shaking and dumping grates. Copies will be sent upon request.

THE CHICAGO FLEXIBLE SHAFT CO., Chicago, Ill., has issued Catalog 80, on "Stewart Porcelain Enameling Furnaces." This catalog describes porcelain enameling methods and furnace construction, from both the metallurgical and the practical shop standpoint, and is a compilation of exceptionally useful information. Many interesting illustrations are given.

THE TERMINAL ENGINEERING CO., INC., New York, calls attention to Publication R229. It contains a description of a truck which can handle the problems of short haul transportation in a new way. It is a combined outdoor and indoor machine, permitting the haulage of goods from any floor of any building to any floor of any other building within reasonable distance. Loads are carried on separate platforms, eliminating loading and unloading delays.

THE WHEELER CONDENSER & ENGINEERING CO., Carteret, N. H., has issued Bulletin 114, on "The Lillie Evaporator," which is for waste waters and solutions generally. In this bulletin are described in considerable detail the features peculiar to the Lillie evaporator and several installations for sugar work, distilling water, and for evaporating many kinds of chemicals, solutions and waste waters. A perspective diagram is also given of the triple-effect and auxiliaries recently installed at the power station of the Chile Exploration Co., Tocopilla, Chile. A copy will be sent to responsible persons upon application.

THE P. H. & F. M. ROOTS CO., Connersville, Ind., has issued a folder on "Gas Exhausters and Boosters."

THE READING IRON CO., Reading, Pa., has issued Bulletin 2, in which is described the structural differences between wrought iron and steel and their relation to the field of welded pipe. It is written in a style that will interest the layman as well as the engineer.

THE BRITISH ALUMINUM CO., New York City, has published an interesting booklet on "The Casting of Aluminum." C. B. ROBERTS ENGINEERING CO., Boston, Mass., has issued an attractive catalog entitled "A Modern Refinery," which is well illustrated.

THE LANCASTER IRON WORKS, INC., Lancaster, Pa., has issued a bulletin on steel plate construction.

THE J. G. WHITE ENGINEERING CORP., New York City, is distributing a folder entitled "Achievement." It gives information about and illustrations of power developments, hydro-electric developments, transmission systems and other important engineering projects in this and in foreign countries.

THE BACHARACH INDUSTRIAL INSTRUMENT CO., Pittsburgh, Pa., has issued a folder which shows its new quarters at Pittsburgh, Pa. The products of the company are given in a two-page folder and consist mainly of gas meters, air meters, pressure recorders, draft recorders, Pitot tubes and orifices, CO₂ indicators, manometers and engine indicators. Manometers and engine indicators are new products and are described in pamphlets G and M. The manometers may be arranged for their pressure, draft or differential pressure. The engine indicator described in pamphlet M may be furnished for evolutions up to 1,500 per minute.

THE MONO CORP. OF AMERICA, New York City, calls attention to a new departure in combustion control devices which is described in an illustrated bulletin, called the Duplex Mono, which is unique in that it automatically analyzes and records the combined percentages of three combustible

gases (CO, CH₄, H₂) during all such times as any or all of these appear in the flue, while it also produces a continuous record of the percentage of CO₂. Both records are on one chart.

HARRIS BROS. CO., Savannah, Ga., and Chicago, Ill., call attention to two bulletins. Bull. NS-1 gives a list of machinery, equipment and supplies which the company has purchased from the National Shipbuilding & Dry Dock Co., while Bull. 505, entitled "Water Tube Boilers," illustrates and describes new boilers which have been purchased from the Government and which were built under rigid Government inspection.

THE COMBUSTION ENGINEERING CORP., New York, has issued an attractive catalog, Bulletin C2, on the Coxe Stoker. This catalog is a revised edition of the old Coxe stoker catalog with supplementary text and revised line drawings.

THE POWER SPECIALTY CO., New York, which has been conducting an investigation into the requirements of oil-heating apparatus in refinery work, with a view to developing a more efficient type of still, has published the results of its investigation in a forty-page bulletin, in which is included descriptions of oil-heating apparatus, drawings of installations, a discussion of the flow of fluids in pipe lines and curves, tables and other data of interest to refinery engineers and superintendents.

JOSEPH T. RYERSON & SONS, Chicago, Ill., has issued a 96-page book on the heat treatment of alloy steels, entitled "The Ryerson Handbook on Alloy Steels." This book, written in an interesting non-technical style by G. VanDyke, manager of the alloy steel department, includes chapters on quality, method of manufacture, elements and the part they play, how to buy and select alloy steels, shop equipment, furnaces, quenching equipment, heat measurement, heating, cooling and quenching, drawing, annealing, testing heat-treated steel, case-hardening or carbonizing and general remarks, together with pen and ink sketches. The book will be sent upon request to buyers and users of alloy steel.

THE WHITE CO., Cleveland, O., announces a new publication entitled "White Trucks in the Oil Industry," which gives in 50 pages pictures and stories illustrative of the prominent part motor trucks are taking today in the development of the oil industry.

THE QUIGLEY FURNACE SPECIALTIES CO., New York City, has published a 16-page booklet on Q-alloys.

New Publications

OUR NEW PLACE IN WORLD TRADE is the title of a booklet recently published by the Guaranty Trust Co. of New York City.

RAW WATER DISTILLING PLANTS FOR PRODUCING DISTILLED BOILER FEED MAKE-UP WATER, by Joseph Price. Compliments of the Griscom-Russell Co., New York.

REPORT OF ACTIVITIES OF THE DIVISION OF INDUSTRIAL HYGIENE AND ENGINEERING for 1918 and 1919, published by the Dept. of Labor and Industry, Harrisburg, Pa.

UNSONDNESS IN STEEL AND FUNDAMENTALS ESSENTIAL TO SONDNESS, with appendix on Ingots and Ingots Molds, by Emil Gathmann and George Dornin, and published by the Gathmann Engineering Co.

COMMERCIAL POSSIBILITIES OF THE UNION OF SOUTH AFRICA. A survey of the recent industrial expansion and the mineral and agricultural resources of a market presenting great possibilities for American enterprise. Issued by the National Foreign Trade Council, India House, Hanover Sq., New York City. Copies will be sent free upon application to O. K. Davis, secretary.

PLATINUM is the title of a publication recently issued by the South American Gold & Platinum Co., New York and Buena-ventura, Colombia.

RAIL REPORTS, which is Bulletin 9, has been published and sent with the compliments of the Titanium Alloy Manufacturing Co., Niagara Falls, N. Y.

OVERHEAD EXPENSES—HOW TO DISTRIBUTE THEM IN GOOD AND BAD TIMES, published by the Fabricated Production Department, Chamber of Commerce of the U. S.

REPORT ON CORROSIVE ACTION AND NATURE OF PRODUCTS FORMED WHEN CARBON TETRA-CHLORIDE EXTINGUISHER LIQUIDS ARE APPLIED TO FIRES. Published by the Underwriters' Laboratories, Chicago, Ill.

MESABI SINTER, PLANT, PROCESS AND PRODUCT OF THE MESABI IRON CO., Babbitt, Minn. Compliments of Clement K. Quinn & Co., Duluth, Minn.

PAPERMAKING MATERIALS. Reprinted from the *Paper Trade Journal* by Arthur D. Little, Inc., Cambridge, Mass.

U. S. TARIFF COMMISSION PUBLICATION: Suggested Reclassification of Chemicals, Oils and Paints. A report to Congress suggesting a reclassification of Schedule A and of related provisions of the Tariff Act of Oct. 3, 1913.

COAL-TAR DYES, for which import licenses were granted during the fiscal year 1920, by Charles S. Hawes. Published by the U. S. Department of State, War Trade Board Section, Washington, D. C.

CHROMIUM ORE, by W. G. Rumbold, published by the Scientific and Technical Department, Imperial Institute, London, England.

ANTIMONY. Published by the Imperial Mineral Resources Bureau, London.

ALUMINUM AND BAUXITE. Published by the Imperial Mineral Resources Bureau, London.

COBALT. Published by the Imperial Mineral Resources Bureau, London.

ZINC. Published by the Imperial Mineral Resources Bureau, London.

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold a meeting at Rumford Hall, Chemists' Club, New York City, on June 10.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN IRON AND STEEL INSTITUTE will hold its nineteenth general meeting in the Hotel Commodore, New York, on Friday, May 27. There will be three sessions: A forenoon session beginning at 10 o'clock daylight saving time (9 a.m. Eastern time); an afternoon session at 2; and a banquet in the evening at 7.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its eighteenth annual meeting at the Hotel Ambassador, Atlantic City, June 9, 10 and 11.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS is holding its spring meeting at the Congress Hotel, Chicago, May 23 to 26.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20. Technical sessions are scheduled as follows: Tuesday, on Preservative Coatings and Textiles; Wednesday, on Cement, Concretes and Road Materials; Thursday, on Ceramics, Lime and Gypsum, on Petroleum Products and on Testing Methods; Friday, on Metals.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-eighth annual convention at the Greenbrier Hotel, White Sulphur Springs, W. Va., the week beginning June 20.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stettlers Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.